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THE PILSBRY QUARTERLY
DEVOTED TO THE INTERESTS OF CONCHOLOGISTS

EDITORS AND PUBLISHERS

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CONTENTS

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THE NAUTILUS

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THE OCCURRENCE OF CYMATIIDAE AND CYPRAEIDAE IN NORTH CAROLINA

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The presence in North Carolina waters of the Cymatiidæ and Cypræidæ families is not well documented and little known to most collectors.

The first published North Carolina record for either family appears to be by Coues (1871) in which a single specimen of *Cypræa exanthema* Linné is listed from vicinity of Fort Macon, N. C. Dall (1903) noted six Cymatiidæ (=Tritoniidæ) and four Cypræidæ in North Carolina waters. Abbott (1954) recorded four Cymatiidæ and no Cypræidae occurring off the North Carolina coast.

The following listing is the result primarily of recent field work from Cape Hatteras south to just below Cape Fear. Most specimens were collected by the author while aboard the Duke University R/V *Eastward,* The North Carolina Division of Commercial and Sports Fisheries R/V *Dan Moore* and the United States Bureau of Commercial Fisheries R/V *Oregon*. Specimens described are in the mollusk collections of the University of North Carolina Institute of Marine Sciences; IMS# indicates catalogue number, IMS#Non indicates specimens not catalogued, live-taken specimens indicated by asterisk following catalogue number. Measurements, when given, are indicated by the following ratio: shell length/shell width in mm.

Cypræa cervus Linné, 1771

RECORDED NORTHERN RECORDS: Dall (1889), south Florida, in same report synonymized *C. cervus* with *C. exanthema* Linne — the latter recorded (1903) from Cape Hatteras. Schielder (1938-39), region between Cape Hatteras to Savannah, rare, record

from earlier collections. Johnson (1934), Smith (1945), Morris (1951) — North Carolina for *C. exanthema cervus* Linné. Dodge (1953), Savannah, Georgia; Abbott (1954), south Florida.

EXAMINED NORTH CAROLINA SPECIMENS: IMS# 1114*, E-SE of Cape Lookout (34°31′ N; 76°14.6′ W), 116 ft. depth, one of five living specimens caught by trawler net fouled in wreck of M/V *Atlas* (an American tanker), 122/69mm, light brown color; IMS# 1852*, SE of New River Inlet (34°09′ N; 76°53.5′ W), 108 ft. depth, *Oregon* station #6557, 119/70mm, dark brown color; IMS# 1626, Cape Lookout beach, broken beach-worn shell; D. A. Wolfe (personal communication), SW of Cape Lookout, 60-100 ft. depth, sight record.

Cypræa cinerea Gmelin, 1791

RECORDED NORTHERN RECORDS: Dall (1889) and Johnson (1934), Cape Hatteras; Smith (1945), Morris (1951), Abbott (1954), Abbott (1968) — Florida.

EXAMINED NORTH CAROLINA SPECIMENS: IMS# 2262, SE of Cape Lookout (34°07.8′ N; 76°11.1′ W), 280 ft. depth, *Eastward* station #10513, shell of a recently dead specimen.

Cypræa spurca acicularis Gmelin, 1791.

RECORDED NORTHERN RECORDS: Dall (1889), Johnson (1934), Smith (1945), Morris (1951) — Florida; Merrill and Petit (1965), Cape Romain, S. C., 180 ft. depth, recently dead specimens (shells common in other nearby dredgings); Menzies, et al. (1966), North Carolina (SE of New River Inlet), shells abundant at *Eastward* stations #1087, 1088, 1089, 213-328 ft. depth. Live specimens were also recorded by Menzies at #1088.

EXAMINED NORTH CAROLINA SPECIMENS: IMS# 33*, Cape Lookout to Cape Fear region, U.S. Bureau of Commercial Fisheries R/V *Albatross III*—cruise #31C, 102-120 ft. depth, 21.4/16.5mm; IMS# 2313, S-SE of Cape Hatteras (35°00′ N; 75°28′ W), 156 ft. depth, *Dan Moore* station #0365, 18.5/11.6mm; IMS#Non *, E-SE of Cape Fear (33°26.0′ N; 77°00.8′ W), 250 ft. depth, *Eastward* station #11554, 18.2/12.8mm. The following were dredged by *Eastward* SE of Cape Lookout: IMS#Non, station #10496 (34°09.8′ N; 76°09.7′ W), 164 ft. depth, 14.2/9.3mm; IMS#Non, station #10497 (34°09.2′ N; 76°10.3′ W), 164-180 ft. depth, 18.1/12.1mm; IMS#Non, Station #11564 34°

09.5′ N; 76°09.2′ W), station #11565 (34°11.8′ N; 76°06.6′ W), station #11569 (34°12′ N; 76°05.9′ W), 230-390 ft. depth, 16.0/10.0mm, 20.1/12.8mm, 20.0/13.2mm and 24.2/16.6mm.

Cypraæa zebra Linné, 1758

RECORDED NORTHERN RECORDS: Coues (1871), Fort Macon, N. C., single specimen; Tryon (1885), Fort Macon, N. C.; Dall (1903), Johnson (1934), Smith (1945), Morris (1951) — North Carolina; Schielder (1938-39), region between Cape Hatteras and Savannah, Georgia, common, record from earlier collections; Dodge (1953), Cape Hatteras; Abbott (1954) and (1968), southeastern Florida. None examined by the author.

Charonia variegata (Lamarck, 1816)

RECORDED NORTHERN RECORDS: Dall (1903), Johnson (1934), Abbott (1954), Clench and Turner (1957) — south Florida; Merrill and Petit (1969), Cape Romain, S. C., 213-262 ft. depth, fragments (one fresh). With a record as close as the latter one, it is only a matter of time before a specimen is found off the North Carolina coast. None examined by the author.

Cymatium (*Cabestana*) *labiosum* (Wood, 1828)

RECORDED NORTHERN RECORDS: Dall (1889), within a few miles of Cape Hatteras (*Tritonium labiosus* (Wood)); Johnson (1934), Cape Hatteras; Abbott (1954), Florida Keys; Clench and Turner (1957), Cape Romain, S. C. (based on specimen removed from buoy by Merrill); Merrill and Petit (1965), Cape Romain, S. C.; Porter and Jenner (1968), Onslow Bay of North Carolina, living specimen.

EXAMINED NORTH CAROLINA SPECIMENS: IMS#Non *, SE of Cape Lookout (34°08.5′ N; 76°10.8′ W), 164 ft. depth *Eastward* station #4487 (sample believed from fore reef area), previously mentioned by Porter and Jenner (1968), 7.2/4.5mm; IMS#Non (identified by Dan Steger), E-SE of Cape Fear (33°31′ N; 76°55′ W), 297 ft. depth, 3.9/3.9mm.

Cymatium (*Linatella*) *poulsenii* (Mörch, 1877)

RECORDED NORTHERN RECORDS: Smith (1937), Lake Worth, Florida, possibly north to Cape Hatteras; Clench and

Turner (1957), Florida; Merrill and Petit (1965), McClellanville, S. C.; Merrill and Porter (1966), two specimens SE of Cape Lookout (108-120 ft. depth), two specimens from Chincoteague Inlet, Virginia (72 ft. depth).

EXAMINED NORTH CAROLINA SPECIMENS: IMS# 1106.1-1106.2 (above recorded specimens), 70/41mm and 63/41mm; IMS# 1247, SW of Cape Lookout, 150 ft. depth, 58/38mm.

Cymatium (*Monoplex*) *parthenopeum* (von Salis, 1793)

RECORDED NORTHERN RECORDS: Dall (1903) for *Tritonium olearium* Linné, Cape Hatteras; Johnson (1934) and Smith (1937) for *C. costatum* (Born), Cape Hatteras; Clench and Turner (1957), Florida; Merrill and Petit (1965), McClellanville, S. C., 246 ft. depth, living specimen; Merrill and Porter (1966), SE of Cape Lookout, N. C., 108-120 ft. depth, two adult shells. Merrill and Porter also record that Dr. Rudolph Scheltema found larvæ of the species in a sample east of the Grand Banks (47°30′ N).

EXAMINED NORTH CAROLINA SPECIMENS: IMS# 1107.1-1107.2 (recorded above), 93/49.5 and 104/54mm (previously recorded 195mm length of #1107.2 is in error); IMS# 2362, S-SE of Cape Hatteras (34°58.5′ N; 75°26.5′ W) and (34°58.5′ N; 75°28′ W), 180-192 ft. depth, *Dan Moore* stations #0359 and 0364, living specimens, 36/19 and 38/20mm. Mrs. E. H. Piper of Gloucester, N. C. has a specimen (length = 111 mm) collected from offshore scallop grounds of North Carolina. Dr. D. A. Wolfe of Beaufort, N. C., has a hermit crab occupied specimen (length = 116mm) found on Radio Island in Beaufort Inlet. This specimen possibly had been brought in by scallop fishermen.

Cymatium (*Septa*) *krebsii* (Mörch, 1877)

RECORDED NORTHERN RECORDS: Dall (1889) and (1903), Johnson (1934)—West Indies and Gulf of Mexico; Clench and Turner (1957), Florida; Merrill and Petit (1965), Cape Romain, S. C., 180 ft. depth, recently living shell.

EXAMINED NORTH CAROLINA SPECIMENS: IMS# 2329, S-SE of Cape Hatteras (34°58.5′ N; 75°26.5′ W), 180 ft. depth, *Dan Moore* station #0359, shell with periostracum, 37/19mm.

Cymatium (*Septa*) *pileare* (Linné, 1758)

RECORDED NORTHERN RECORDS: Dall (1889) and (1903), Johnson (1934), Morris (1951) — Florida; Abbott (1954), North Carolina; Clench and Turner (1957), Florida; Merrill and Petit (1965), Cape Romain, S. C., 213-262 ft. depth, fragments. None examined by the author.

Cymatium vespaceum (Lamarck, 1822)

RECORDED NORTHERN RECORDS: Abbott (1954), North Carolina; Clench and Turner (1957) for *C. gemmatum* (Reeve), southern Florida. None examined by the author.

Distorsio (*Rhysema*) *clathrata* (Lamarck, 1816)

RECORDED NORTHERN RECORDS: Dall (1889) lists two varieties—*reticulata* and *clathrata*. As indicated by Clench and Turner (1957), these varieties are now recognized as the following respective species—*D. clathrata* (Lamarck) and *D. mcgintyi* Emerson and Puffer. Dall (1889) for variety *reticulata,* Caribbean; Dall (1889) for variety *clathrata,* Cape Hatteras, 132-744 ft. depth, common; Dall (1903) for species *reticulata,* Cape Hatteras; Johnson (1934) for *D. clathrata* (= D. reticulata), Cape Hatteras; Smith (1945) and Morris (1951), Florida; Clench and Turner (1957), Cape Hatteras; Abbott (1954), North Carolina; Cerame-Vivas and Gray (1966), Carolinian and Tropical provinces off North Carolina.

EXAMINED NORTH CAROLINA SPECIMENS: IMS# 1268.1-1268.2*, 102 ft. depth off Cape Hatteras; IMS# 2363.1-2363.60*, E-SE of Cape Hatteras, *Dan Moore* stations: #0359 (34°58.5′ N; 75°26.5′ W) at 180 ft. depth, #0360 (34°59.5′ N; 75°28′ W) at 150 ft. depth, #0361 (34°59′ N; 75°30.5′ W) at 141 ft. depth, #0362 (34°57.5′ N; 75°31′ W) at 141 ft. depth, #0364 34°58.5′ N; 75°28′ W) at 186 ft. depth, #0365 (35°00′ N; 75°28′ W) at 153 ft. depth, #0366 (35°02′ N; 75°28.5′ W) at 123 ft. depth, 17.5/12.0 to 46.0/26.0 with an average of 34.8/19.8mm; IMS# 1096.1-1096.11*, SE of Cape Lookout, 108-120 ft. depth; IMS# 2305*, E of Cape Lookout (34°34′ N; 76°01′ W), 111 ft. depth, *Dan Moore* station #0371. L/W measurements of total above specimens ranged between 17.5/12.0 and 67/40mm.

Distorsio (*Rhysema*) *mcgintyi* Emerson and Puffer, 1953

RECORDED NORTHERN RECORDS: Dall (1889) for *Distortrix reticulata* var. *clathrata,* Cape Hatteras, common; Abbott (1954) for *D. constricta mcgintyi,* North Carolina; Clench and Turner (1957), Palm Beach, Florida; Cerame-Vivas and Gray (1966), Carolinian and Tropical provinces off North Carolina; Menzies, et al. (1966), E of Cape Fear (*Eastward* stations #1087 and 1088), scarce at both stations, living specimens present at #1088.

EXAMINED NORTH CAROLINA SPECIMENS: IMS# 2359*, S-SE of Cape Hatteras (34°58.5′ N; 75°28′ W), 186 ft. depth, *Dan Moore* station #0364, 23.4/13.2mm; IMS# 1726.1-1726.2, SE of New River Inlet (33°43.4′ N; 76°41.7′ W), 213 ft. depth, *Eastward* station #1088, 13.5/7.8 and 16.8/9.6mm; IMS# Non, S and SE of Cape Lookout, *Eastward* stations: #4487 (34° 08.5′ N; 76°10.8′ W) at 164 ft. depth, #7226 (34°12.2′ N; 76° 07.2′ W) at 230 ft. depth, #7230 (33°52.5′ N; 76°28.5′ W) at 246 ft. depth, #7238 (33°52.0′ N; 76°28.8′ W) at 269 ft. depth, 35/22.3mm, 38.8/23.5mm, 24.1/13.5mm, 7.9/4.6mm, 7.9/4.6mm, 7.0/4.2mm; IMS# 2230*, SE of Cape Lookout (34°09.2′ N; 76° 10.3′ W), 170 ft. depth, *Eastward* station #10497, 26.8/16.4mm; IMS# 2249, SE of Cape Lookout (34°07.2′ N; 76°12.6′ W), 272 ft. depth, *Eastward* station #10508, 23.5/14.8mm.

Discussion

The species *Cypræa cervus, C. cinerea* and *C. spurca acicularis* occur off the North Carolina coast. These data reinforce earlier published records questioned by recent authors.

Some confusion is indicated in the literature as to occurrence of *C. cervus* and/or *C. zebra* off the North Carolina coast. While *C. cervus* has been collected living in North Carolina waters at a depth just greater than 100 ft. near beds of *Aequipecten gibbus,* no specimens of *C. zebra* from North Carolina are known to exist. Possibly Coues specimen of *C. zebra* was misidentified by Stimpson. Dall (1903), later recording *C. exanthema* north to Hatteras, may have been referring to Coues record. Johnson (1934), listing both *C. e. exanthema* and *C. e. cervus* from North Carolina, may have been referring both to Coues (1871) and Dall (1903). Location of the Coues specimen is not known. Abbott (personal communication) was unable to find it in the Philadelphia Academy of

Natural Sciences mollusk collection and the author found no record of North Carolina specimens of these two species in the mollusk collection of the United States Museum of Natural History.

Cypræa cinerea and *C. spurca acicularis* occurred in deeper water than *C. cervus,* about 70 km. off the North Carolina coast near a submerged, Lithothamnion type reef (for reef reference see Menzies et al., 1966).

Of the species *Cymatium labiosum, C. poulsenii, C. parthenopeum, C. krebsii, Distorsio clathrata* and *D. mcgintyi* occurring off the North Carolina coast, only the record of *C. krebsii* is new. *Cymatium pileare* and *C. vespaceum,* while recorded from the area by Abbott (1954), have yet to be seen by this author. Because of the well-known highly adventurous nature of Cymatiid larvæ, it can be assumed that the two preceding species and possibly others in the family will be found off the coast of North Carolina.

Collections in the Institute of Marine Sciences indicated *D. clathrata* to be common east-southeast of Cape Hatteras at depths between 106 and 186 ft. and *D. mcgintyi,* possibly less common, to be found only in deeper waters near the submerged reef of Menzies et al. (1966). Dall's statement (1889) that *D. mcgintyi* = *Distortrix reticulata* var. *clathrata* is common off Cape Hatteras and that *D. clathrata* = *Distortrix reticulata* var. *reticulata* is found only in the Caribbean seemed to be an inverted error. Examination of specimens in the United States Museum of Natural History showed that Dall had not collected any *D. clathrata* from North Carolina waters.

Of recorded North Carolina *Cymatium* spp., only *C. labiosum* occurred near the above mentioned offshore reef while the others were further inshore and near the *Aequipecten gibbus* beds.

The author here wishes to express his appreciation to the Gear and Development Division of the United States Bureau of Commercial Fisheries, the North Carolina Division of Commercial and Sports Fisheries, the Oceanographic Program of the Duke University Marine Laboratory, the United States National Museum—Division of Mollusks and the staff of the University of North Carolina Institute of Marine Sciences for their part in this paper.

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EGGS AND ATTACHMENT SITES FOR EGG CAPSULES OF VALVATA LEWISI

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The literature pertaining to reproductive features of *Valvata* Müller has been reviewed by Heard (1963). In this paper, the author pointed out the seasonal reproduction of *V. piscinalis* of Europe and *Valvata* of the Great Lakes region. Besides the seasonal reproductive cycle, certain species of *Valvata* demonstrate a preference for substrates during oviposition. Heard demonstrated that *V. tricarinata* (Say) preferred plants over leaves of decidous trees for oviposition. Also, more egg capsules were recovered from the broader leaved aquatic plants than those having narrow or needle-like leaves. The number of eggs per capsule and the time rquired for hatching is quite variable for the various species of *Valvata* that have been studied.

Valvata lewisi Currier has been reported from the western states

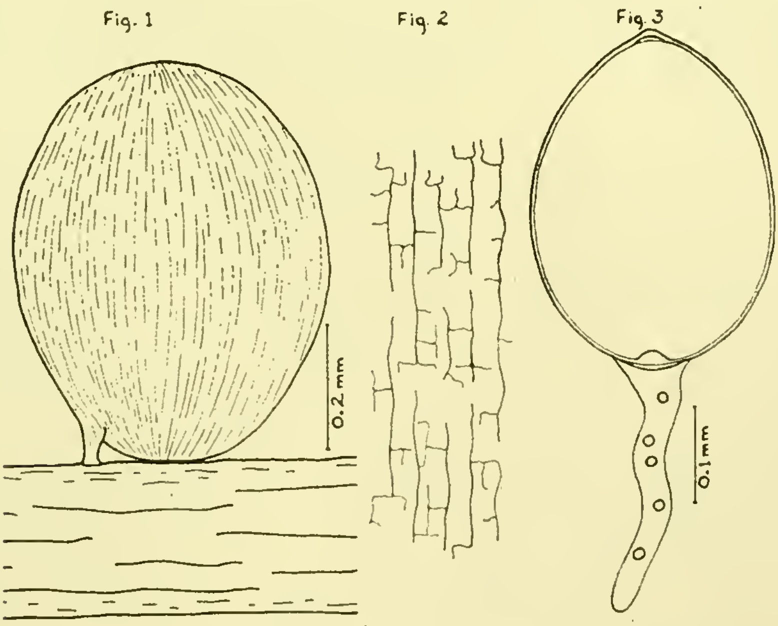

Figure 1. Egg capsule of *Valvata lewisi* attached to aquatic plant.
Figure 2. Incomplete surface striations on egg capsule.
Figure 3. Single egg showing filament.

by Henderson (1907, 1929) and Beetle (1965). In the present study, oviposition (egg capsule attachment) on various substrates was studied for *V. lewisi* along with the morphology of the capsule and egg, and the hatching time for eggs.

Valvata lewisi are present in the three Findly Lakes on the Turnbull National Wildlife Refuge in eastern Washington (Spokane Co.). The three lakes are connected by ditches and the smallest of the three usually dries up in the summer. The lakes are shallow, 2.5 meters at their greatest depth with a mud-silt bottom over one meter in depth, eutrophic, with a pH which varies from 7.2 in early spring to 9.5 in late summer. Total alkalinity is high and the oxygen concentration shows considerable diurnal and seasonal variation, from 20 percent saturation to 95 percent saturation. The dominant plant species covering the bottom of the lakes is *Myriophyllum exalbescens* Fern. Small patches of *Elodea canadensis* Michx. are scattered over the bottom, and the banks and edges are characterized by *Typha latifolia* L. *Pinus ponderosa* Dougl. is the dominant species of tree with a few *Populus tremuloides* Michx. being present. The invertebrate fauna of the lakes is extremely rich.

Adult *V. lewisi* are usually not found in field collections until after April 1. Collections during January, February and March do not contain adults or young. Specimens are common throughout April, but become increasingly difficult to obtain by the middle of May.

Adult snails collected during the middle of April were maintained in aquaria in the laboratory for three days. At this time, 24 snails were transferred to four 4½ inch fingerbowls, six snails per bowl. Each fingerbowl contained filtered lake water, leaves of *Acer saccharinum* L. and P. *tremuloides,* sprigs of *E. canadensis* and *M. exalbescens,* and small portions of the stalk of *T. latifolia.* With the exception of the Maple leaves, these plants are present in and around the Findly Lakes. Snails were maintained at room temperature and were exposed to the natural photoperiod. Fingerbowls were checked at intervals for egg capsules and their site of attachment. Snail feces were removed at intervals and fresh water was added.

During an 18 day period, 50 egg capsules were laid by the 24 snails. Forty egg capsules were studied in detail during this pe-

riod. The minimum hatching time is 12 days, the range being 12 to 18 days. From 2 to 6 eggs are present per capsule; the mean number of eggs per capsule is 4.1. Capsules that are 24 hours old range in size from 0.675 mm to 0.800 mm long. The egg capsule is connected to the substrate by a short fiber (Fig. 1). Incomplete surface striations are present on the capsule (Fig. 2). Eggs (Fig. 3) that are 24 hours old are 0.350 mm to 0.368 mm long (excluding the filament). The single filament present on each egg varies from 0.175 mm to 0.200 mm in length. Filaments of eggs are not joined. The capsule splits along a longitudinal suture, releasing the eggs which hatch within 24 hours. The shells of the young snails show course transverse striations.

Of the substrates provided for capsule attachment, *V. lewisi* demonstrated a high selectivity for the stalk and leaves of *M. exalbescens* (Table 1). The broader leafed *E. canadensis* and the leaves of the tree species were not favored as sites for capsule attachment. In fact, the snails seemed to prefer glass above all other substrates except *M. exalbescens.* This might be a reflection of the total surface area that was available.

Unlike *V. tricarinata, V. lewisi* preferred the narrow leafed aquatic *Myriophyllum* to the broader leafed plant *Elodea. Valvata lewisi* has from 2 to 6 eggs (average 4.1) per capsule which is close to the number of eggs recorded for *V. cristata* and *V. tricarinata* (Heard, 1963). The hatching time for *V. lewisi* (12-18 days) at room temperature closely resembles that seen for *V. tricarinata* (Furrow, 1931). In *V. lewisi* each egg case has its own individual thread, much like *V. tricarinata* and *V. cristata.* The egg capsule of *V. lewisi* splits along a longitudinal suture as the embryos increase in size, spilling the egg cases to the bottom. This is also seen in *V. piscinalis* and *V. tricarinata.* The embryonic snails of *V. lewisi* appear to eat their way through the membranes of the egg case as seen in *V. tricarinata.* Thus, in certain aspects of reproductive biology, *V. lewisi* appears to resemble *V. tricarinata,* except that *V. lewisi* prefers the narrow leafed aquatic plant *Myriophyllum* for egg capsule attachment.

The authors are grateful to Mr. Jon Malcomb, Manager of The Turnbull National Wildlife Refuge, for his encouragement and help during this study.

TABLE 1. Substrates and attachment sites for egg capsules of Valvata lewisi

	Substrates					
	Myriophyllum exalbescens	Glass	*Typha latifolia*	*Elodea canadensis*	*Acer saccharinum*	*Populus tremuloides*
Number of capsules	29	15	3	2	1	0

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ONE MORE SINISTRAL MESODON

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A sinistral specimen of *Mesodon inflectus* (Say, 1821) was found with two dextral snails of this species. The specimens were obtained in the damp soil under a large slab of rock, in a steep talus slope formed by the highway construction of Routes 19E and 321, just south of Valley Forge, Carter County, Tennessee.

Sinistral or left-handed specimens of *Mesodon* are uncommon. Over a hundred years ago, Tryon (1867, p. 104) wrote, "Reversed Helices are not nearly so numerous in America as in Europe." He listed the number of sinistral specimens of species which are now known to belong to the genus *Mesodon*. He cited single sinistral examples of *M. elevatus* (Say, 1821), *M. thyroidus* (Say, 1816), *M. mitchellianus* (Lea, 1839) and *M. inflectus*. The second sinistral *inflectus* was collected by Leslie Hubricht in St. Louis County, Missouri, and reported by Pilsbry (1940, p. 773).

A. G. Weatherby (1895, p. 94) reported three specimens of sinistral *M. thyroidus* and one of *M. mitchellianus*. Some of these

records may be duplicates of those reported by Tryon 18 years previously. Archer (1934, p. 148) reported two more sinistral shells of *M. thyroidus*. Fluck (1934, p. 105) reported two left-handed shells of *M. zaletus* (Binney, 1837). Reigle (1962, p. 37) in summarizing Pilsbry's (1940) data, noted that "Reversely coiled snails have been recorded from a great many groups. Among the Polygyridæ, this condition is unusual, but has been found in at least 10 species and 4 genera". Only two of these 10 species belong to the genus *Mesodon*. To substantiate Tryon's statement concerning relative abundance of European and American helices, Knight (1905, p. 116-119) lists 11 species and 66 specimens of sinistral helices from England.

The three specimens of *M. inflectus*, including the left-handed shell, collected by the author have been deposited in The American Museum of Natural History, AMNH No. 157293.

The presently recorded specimens were collected on June 4, 1969, in the company of (but not under the same rock as) *Mesodon rugeli* (Shuttleworth, 1852), *Triodopsis rugosa anteridon* Pilsbry, 1940, *T. albolabris* (Say, 1816) and *Stenotrema stenotrema* (Pfeiffer, 1842). The subadult, sinistral shell measures: Ht. 5.2 mm.; Diam. 9.2 mm. The two dextral shells measure: Ht. 5.8 mm., Diam. 10.0 mm.; and Ht. 5.2 mm., Diam 9.2 mm.

I wish to thank Dr. William K. Emerson for kindly reading the draft of this manuscript

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DEFENSIVE LIQUID DISCHARGE IN FLORIDA TREE SNAILS *(LIGUUS FASCIATUS)*

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During recent field work on Lignumvitae Key, located near Islamorada in the central Florida Keys, we noticed that individuals of the Florida tree snail *Liguus fasciatus* almost invariably discharged copious quantities of a clear aqueous liquid when prodded on the shell or body or picked off their arboreal perches (see Figure 1 A-B). Simultaneously the body was retracted for a variable distance inside the shell. In order to test the obvious hypothesis that this is a defensive response, we carefully transferred leaves bearing crawling snails next to a freshly disturbed nest of the large, aggressive ant *Camponotus floridanus*. Most of the worker ants were deterred by simple contact with the slimy surfaces of the crawling snails. However, on several occasions workers persisted long enough to attempt to bite soft portions of the bodies of the snails. In these instances the *Liguus* performed the withdrawal-and-discharge response; whereupon the ants released the snails at once and made no further attempt to cross the barrier of discharged liquid (see Figure 1 C-E).

We did not attempt to learn whether the discharge also serves as a deterrent to attack by vertebrate predators. It may be significant that so many different kinds of tree snails, like *Liguus,* are brightly colored and rest in exposed positions on the trees and bushes they inhabit. We suggest that the coloration might be aposematic, operating in connection with the discharge response or some comparable chemical defense mechanisms in the various species of tree snails.

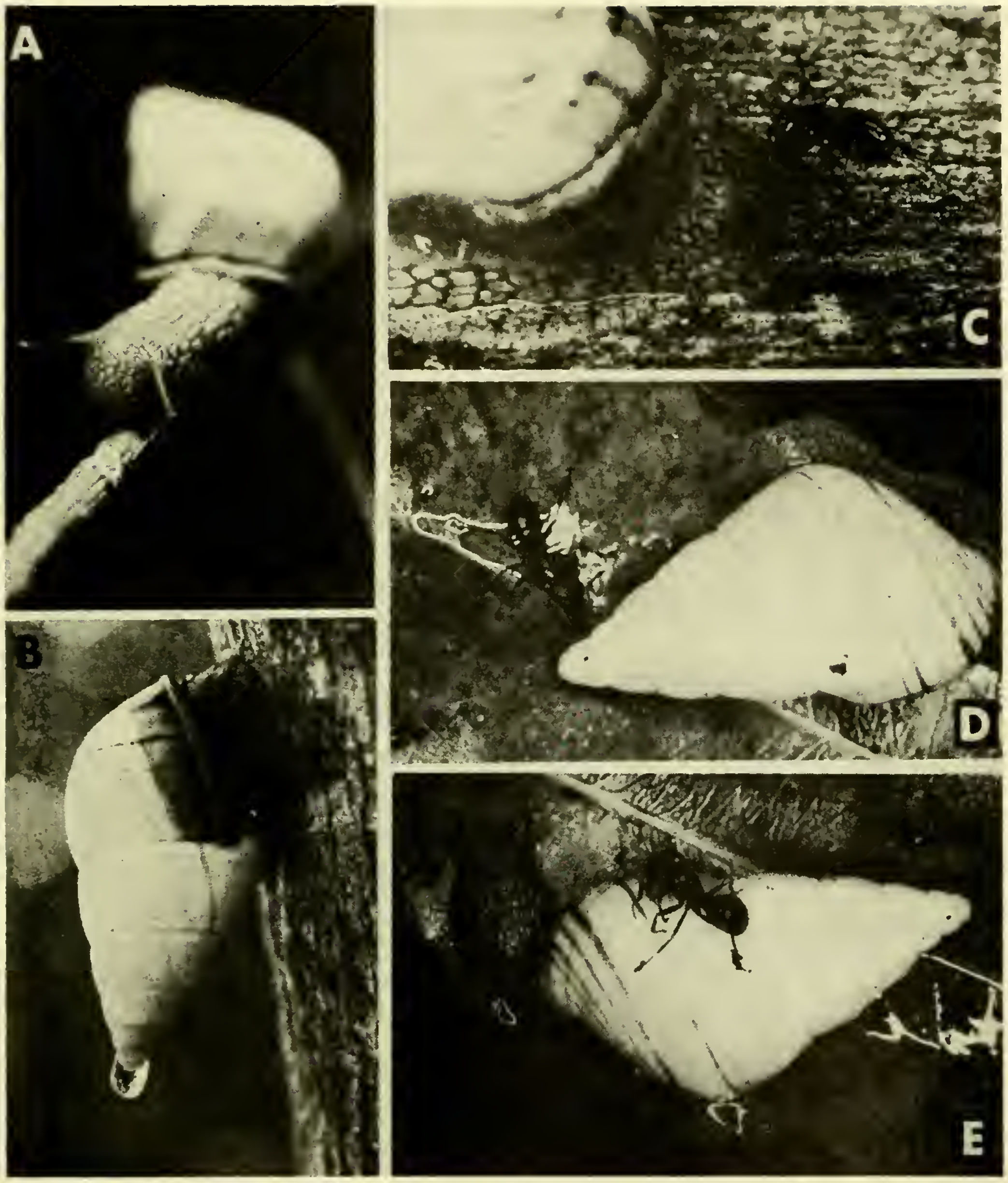

Figure 1. *A, Liguus,* crawling on twig. *B,* Disturbed individual, partly withdrawn into shell, showing drop of discharged fluid. *C, Liguus* in the process of withdrawing from an ant. Freshly discharged liquid is seen to bathe the foot of the snail. *D,* Ant struggling to escape from pool of liquid discharged by snail. *E,* Ant perched atop a snail shell, cleaning itself after having become contaminated with the discharge. Note particulate debris stuck to wetted feet of ant.

GROWTH OF *AMBLEMA PERPLICATA* CONRAD (PELECYPODA) IN A TEXAS RIVER

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Growth studies of fresh-water clams under natural conditions in this country are rather scarce. Lefevre and Curtis (1912) recovered 3 *Lampsilis ventricosa* Barnes at LaCrosse, Wisconsin, where they were kept for 2 years (June, 1908-November, 1910) in a wire cage. Howard (1922) reported that 10 *Quadrula pustolosa* Lea, maintained in a concrete lined pond at Fairport, Iowa (1913-1916) grew an average 4.44-19.79 mm. Grier (1922) and Chamberlain (1931) recorded the age and growth (based on an analysis of rings) of several species of clams from different areas of the United States.

Our material was originally collected for a study in parasitology. The data are presented here, nevertheless, to show the growth of a clam from a southwestern river, under natural conditions (excluding possible pollution), and to obtain some general idea of the existing population and its abundance.

Materials and Methods

On April 7-8, 1966, a total 190 live clams were collected from an area in the Little Brazos River, approximately 5 miles from the mouth (Robertson County, Texas). The pool was 40 m in length, 5-7 m wide, with an average depth of 1 m. The bottom topography consisted of loose sand and hard, even mud. The clams were burrowed in the mud in clumps or occurred singly. The river itself flows slowly through a flat agricultural region, and undoubtedly contains varying amounts of insecticide residuals.

The unsexed mollusks were placed in pails of river water until they were marked, weighed and measured. The clams were dried with a towel and numbered on their disks with red fingernail polish. They were weighed to 0.1 g and measured (height and length) to the nearest mm, and returned to the same pool. No mollusk was out of the stream longer than 3 hours.

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Table 1. The species and number of clams (living) present and recovered from a pool in the Little Brazos River. (Robertson County, Texas)

Species	Number of clams marked April 7-8	Number recovered September 16
Amblema perplicata	110	44*
Proptera purpurata	32	2
Anodonta corpulenta	18	1
Quadrula forsheyi	16	
Quadrula houstonensis	5	
Lampsilis sp. A	5	
Lampsilis sp. B	4	
Total	190	46

*1 dead (not included in Fig. 2)

Chemical or physical data were not obtained. According to the U. S. Weather Bureau, rainfall was approximately 22 inches for the period under study; the river over-flowed on at least one occasion.

Results

On September 16, 1966, after a careful search 45 living, marked clams were found. An undetermined number of unmarked clams were also found. (There were all similar in size, and it is assumed they were new to the pool and not marked clams with eroded numbers.) One dead marked clam was also located.

In Table 1 the total number of species initially found and marked are compared to the marked ones subsequently recovered. The washboard clam, *Amblema perplicata* Conrad, was the most abundant species in both collections. As noted in Table II, a comparison was made of individual growth rates, in terms of weight, length and height between April 7 and September 16. Occasionally, there was an increase in weight without a concomitant increase in size, and in a few cases there was actually a small decrease in length. The dead, marked *A. perplicata* had grown 9 mm

Table 2. A comparison of the growth of A. perplicata, (Group I, the 6 smallest; Group II, 6 of intermediate range; Group III, the 6 largest) P. purpurata and A. corpulenta.

Species	Weight (grams) April	Weight (grams) Sept.	Length (mm) April	Length (mm) Sept.	Height (mm) April	Height (mm) Sept.
A. perplicata	15.9	33.0	39	48	32	40
	24.9	46.6	45	56	38	46
	34.2	dead	51	60	42	46
Group I	41.3	69.7	55	65	43	51
	42.5	65.6	63	64	44	55
	43.7	65.2	54	61	44	51
	170.0	191.7	86	90	69	70
	170.1	191.5	81	84	67	68
Group II	170.1	175.9	90	80	67	67
	180.2	188.6	87	88	67	67
	180.3	187.9	95	95	65	65
	182.4	193.7	83	85	68	68
	245.4	255.4	101	102	76	77
	249.0	260.0	96	97	73	73
Group III	255.1	264.0	104	104	73	73
	271.9	281.4	101	101	76	76
	272.0	280.8	97	95	70	70
	309.2	320.9	106	106	78	78
P. purpurata	57.2	78.5	65	73	47	51
	63.2	78.0	67	72	48	51
A. corpulenta	152.9	153.0	105	105	65	65

in length before drying. The April collection group contained the smallest population between 6 and 7 cm, but had a relatively large population below and above that length (Fig. I). In September, the largest population consisted of clams that were over 8 cm in length with only one specimen falling below 6.5 cm.

In Figure 2 the relationship between weight and length is shown for the 110 *A. perplicata* from the April collection.

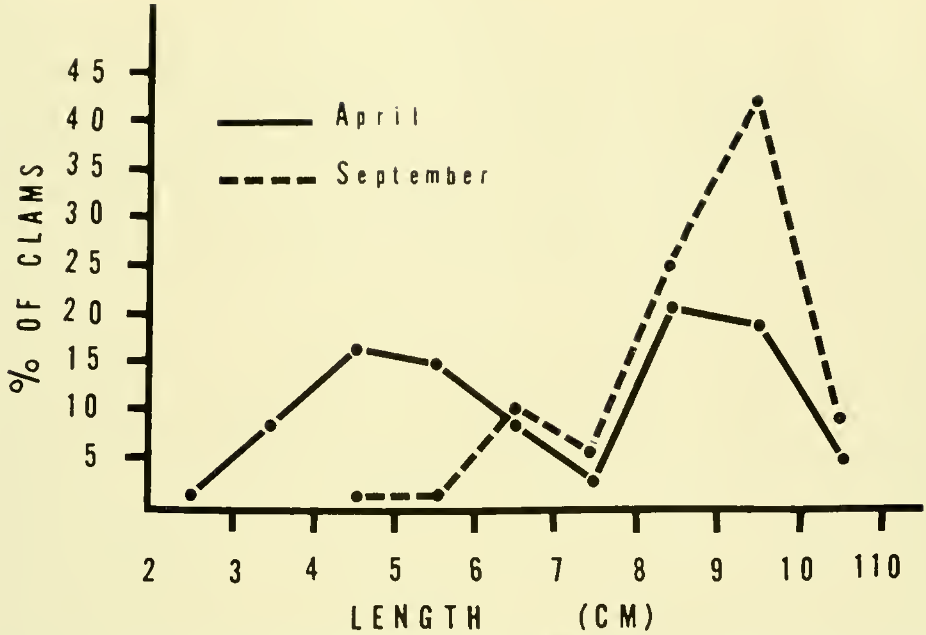

Figure 1. The length-frequency for 110 *Amblema perplicata* from the April collection as compared with 43 *Amblema perplicata* from the September collection.

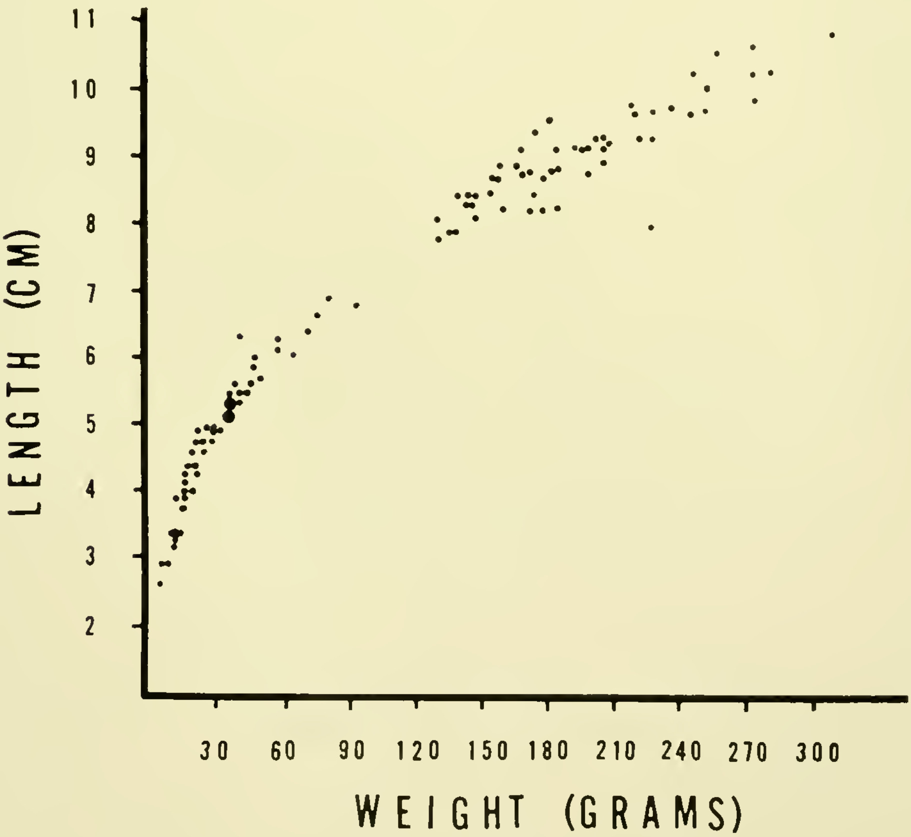

Figure 2. Scatter diagram of the relationship between weight (living) and total shell length for 110 *Amblema perplicata* from a single pool in the Little Brazos River, Robertson County, Texas. Large circles represent 2 to 4 clams of the same length and weight.

Discussion

Amblema perplicata was clearly the most abundant clam (Table I). This substantiates the data of Gentner and Hopkins (1966) who reported similar findings. *Proptera purpurata* Lamarck, the second most prevalent species in this study, was not reported by the above workers after the 1950-1956 drought; the cause of this fluctuation is unknown.

The relatively fast growth of the younger clams as compared to older ones is similar to the growth pattern of most multicellular organisms. Okland (1963) found the same growth in a European clam, *Anodonta piscinalis* Nills. It appears that many of the larger clams reached a stationary phase in length and height; nevertheless, all clams except the *Anodonta corpulenta* Cooper gained several grams. Although all *A. perplicata* increased in weight, it seems certain that a few were approaching a plateau. For example, notice the clams weighing 245.4 and 309.2 grams respectively, from the April collection (Table II).

That these relatively large clams had reached a stationary phase in growth becomes more apparent when one considers the period of the study was made within a maximal growth period (Howard, 1922). Similarly, Rubbel (1912) observed relatively slower growth in larger *Margaritana margaritifera*.

The individual variation in growth is difficult to evaluate. For example, in April we found 3 *A. perplicata* that weighed 170.0 to 170.1 g, respectively (Table II). Two of these clams gained approximately 21 g in weight and 3-4 mm each in length. The 3rd bivalve gained less than 6 g in weight and did not grow lengthwise.

The relatively small 6 to 7.5 cm population (64 to 120 g in wt) of *A. perplicata* in the April group could reflect the ill effects of the 1950-1956 drought. The greatest percentage of *A. perplicata* in the September collection were the larger clams. This suggests that smaller mollusks (under 50 g) were unable to re-establish themselves after they were returned to the pool, or alternatively, were dislodged more readily during a flash flood.

Since all clams were recovered from the same pool in which they were originally found, there was a lack of migration for these specimens. Presumably, the unmarked clams (all were *A. perplicata*) moved in from other areas of the stream, as they were approximately all the same size. (It is unlikely the fingernail polish

dissolved since the numbered molluscs recovered showed no evidence of mark deterioration.) The smaller specimens grew faster in length than the larger clams, and after a stationary length was obtained, growth was manifested chiefly by an increase in weight.

ACKNOWLEDGEMENT

We thank Professor Harold Harry for reading and criticizing the manuscript.

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ALTERATIONS IN THE MOLLUSCAN FAUNA OF A MEROMICTIC, MARL LAKE

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ABSTRACT

Documented alterations of the physical characteristics in Green Lake, Onondaga County, New York, have correlated with changes in the species composition of the molluscan fauna. Data indicates that in the recent past rather extensive shallow littoral waters supported dense populations of the larger pulmonate gastropods. A reduction in lake level occurred that practically destroyed these warm shallow areas. At this time, the littoral zone consists of an

extremely narrow and precipitous band around the lake, that supports only depauperate populations of mollusks.

Introduction[1]

The basin of Fayetteville Green Lake is located in deposits of Onondaga Limestone a few miles east of Syracuse, New York. It is characterized by precipitous shores, biohermic marl shelves at the water's surface, high transparency, and its meromictic qualities (Berg, 1963). It is fed almost entirely by ground water. The one important inlet is a small intermittent stream that empties Round Lake, a smaller meromictic lake to the southwest (Fig. 1). Green Lake is about 1200m long, 400m wide, has a maximum depth of 61m and a surface area of about 26ha (Harman and Jackson, 1967). It is flask shaped with the neck of the flask, the outlet region, projecting northeast from the main basin (Fig. 1). The outlet flows northwest into Chittenango Creek which in turn enters Oneida Lake. Oneida lies in the Oswego River Watershed of the St. Lawrence Drainage Basin. Both Green and Round Lakes were apparently formed as plunge basins during the last deglaciation between 11,000 and 12,000 years ago (Nichols, 1967; Muller, 1967).

Methods

Samples of fresh-water mollusks have been taken from littoral vegetation, surficial sediments, and from cores in various parts of Green Lake. Collections have also been taken by coring and hand collecting along the shores above the present surface of the Lake and in the low-land between Round and Green Lakes. In all cases where the collections included substrate and sub-fossil mollusks, they were washed, and counted as described by Sparks (1961). Surficial sediment samples were taken in the "neck" of the Lake (Fig. 1, 21-26; Table 2) utilizing dividing equipment. Plastic bags were carried underwater to the collecting areas and masses of characeous vegetation and inorganic substrate, including sedentary organisms, were stuffed into the bags. Upon reaching the laboratory, the samples were dried for future sorting and identification of mollusks. Samples of living mollusks were collected throughout the Lake with a Walker dipper or by the utilization of diving equipment. General collecting of living mollusks has taken place

[1] I wish to acknowledge data and ideas of Dr. G. J. Brunskill, now holding a position at the Fisheries Research Board of Canada, who was originally intended to be co-author of this manuscript.

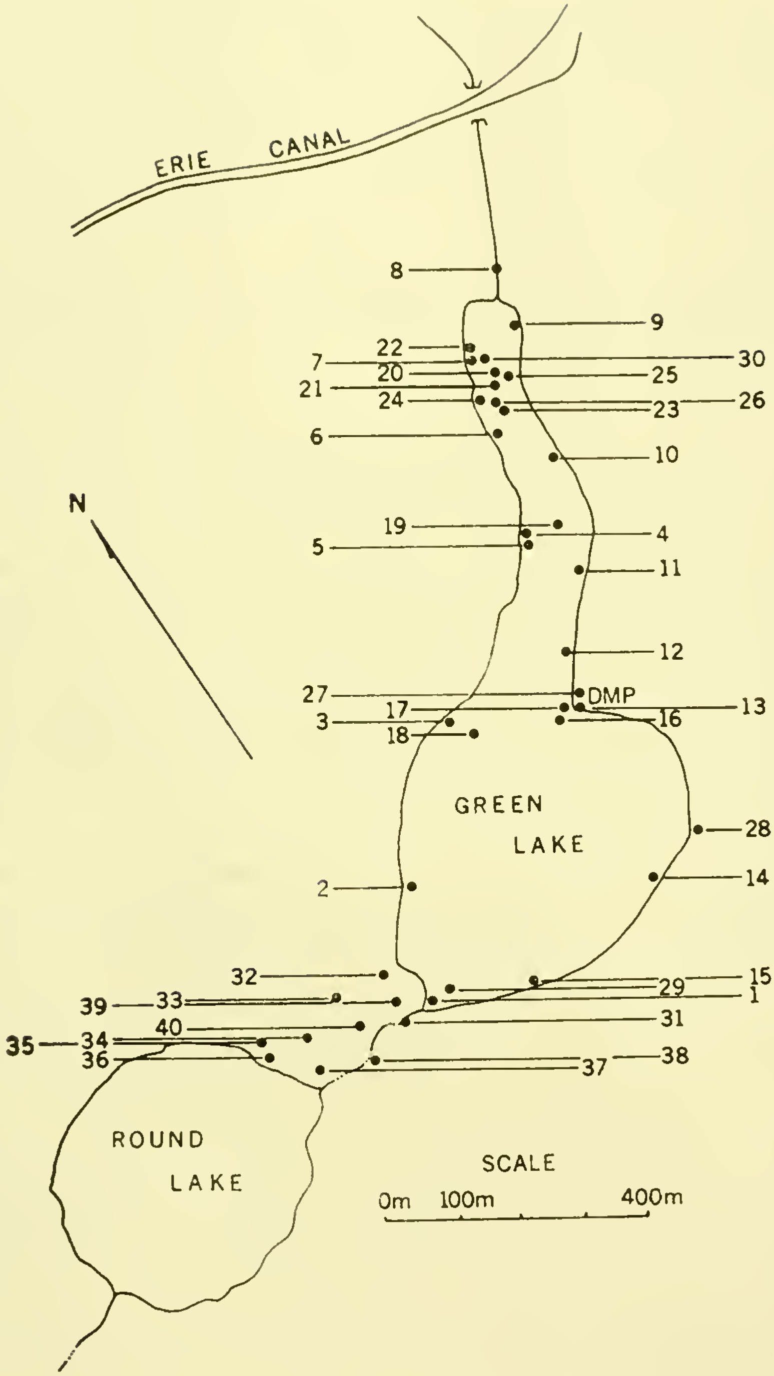

Figure 1. Collection areas at Green Lake, Onondaga County, New York. 1-15 littoral samples of mollusks; 16-20 sub-littoral and profundal samples of mollusks; 21-26 surficial sediment samples; 27-31 Green Lake core samples; 32-40 between lake core samples.

all along the shores. Five cores were taken above and below the water level of Green Lake by driving an aluminum alloy, 4cm diameter core tube into the substrate by hand or with a hammer. Fifteen centimeter portions of the bottom and top of each core were taken as samples. Table 1 shows each species as a per cent of the entire sample population from the bottom and top of each core. Table 1 also illustrates the makeup of the living molluscan community collected in core number 30. Core 27 was taken from the marl bioherm at Deadman's Point (Fig. 1, DMP) about 1m above the present water level. Core 28 was taken from a buried marl shelf 40 cm above the water level in the SSE sector of the Lake, as shown in Fig. 1. Core 29 was collected from a marl substrate in about 5m of water (Fig. 1, 29). Core 30 was taken in the present littoral zone in a *Chara* bed, having living snails at the top of the core (Fig. 1, 30). Core 31 was from the land mass separating Green and Round Lakes (Fig. 1, 31) at an elevation above lake level of less than one meter. Samples collected in the low-lying area between Green and Round Lakes (Fig. 1, 32-40) were taken to determine the stratigraphy and origin of the underlying soils.

In all the samples it is apparent that there has been a great deal of post mortem sorting and transport of empty shells. In the precipitous littoral areas slumping has often occurred creating all kinds of pseudo-associations. Furthermore, erosion of marl deposits now above the surface of Green Lake results in the continual contamination of even recent surficial sediments with sub-fossil specimens washing down from above. Because of these phenomena I believe that more than a comparison between living (including recently dead) and sub-fossil molluscan species lists would be misleading and contain serious errors. Shells have been considered "recently dead" if they still retain their translucent appearance and if all periostracal and shell pigments remain as they are in living specimens.

Comparison from one core to another is only possible by some method of dating or correlation. Absolute elevation is the only criterion of age that has been feasible to use. I feel it is acceptable, because the change in molluscan fauna has been so recent that many extinct species are still found on the surface of even undisturbed sediments.

Reductions in Lake Level

The surface level of Green Lake has dropped about 1.5 to 2.0m in the recent past. Important evidence of higher water levels in Green Lake is demonstrated by the presence of soft marl terraces that occur sporadically around the Lake about 2m above the present surface. These benches are particularly well developed in the vicinity of Deadman's Point. The deposits contain several species of aquatic mollusks in abundance and were obviously laid down as sub-surface lacustrine sediments. Cores 27, 28, and 31 were taken in these areas.

Another indication of higher water levels in Green Lake is reflected in the former drainage pattern between Round and Green Lakes. The elevation of Round Lake is about 3m above the present surface of Green, being separated from the latter by a broad valley. Cores taken in this lowland, (Fig. 1, 32-40) show sorted layers of organic matter, fine grained marl deposits containing aquatic mollusks, and clay in discontinuous and independent patterns. It is apparent that marshes or a very slow-moving braided stream occupied this site. These types of environment could not have been present if the two lakes had not once had approximately the same surface elevation.

Indirect evidence lies in the relationships between the biohermic shelves in both lakes and the respective water levels in each. Active bioherms in Round Lake are found about 1.5m below the water's surface. These reef-like masses in Green Lake are at the present surface of the water and appear to be wasting away. Since the formation of the bioherms in both lakes can be assumed to have the same origin, it would seem that these structures would have been formed at about the same depths. It appears that the formations in Round Lake remain active because they have maintained the same relationship to the factors tending to build them since their genesis. The reefs in Green Lake are victims of a changing environment and are now being degraded. Since the latter are presently at the surface, and those in Round Lake are 1.5m below the surface, the indication is that the level of Green Lake has lowered about 1.5m.

The ages of trees growing in the bottom land between the lakes, as determined by increment borings, and historical data concerning the construction of the Erie Canal, indicate that the level of

Table 1. Green Lake Core Samples

	27			28			29			30			31		
	B*	T*	L*	B	T	L	B	T	L	B	T	L	B	T	L
Goniobasis livescens	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-
Amnicola lustrica	40	22	-	21	7	-	27	32	-	9	15	34	-	17	-
Valvata tricarinata	16	+	-	11	20	-	+	12	-	62	61	24	-	27	-
Lymnaea humilis	13	22	-	7	4	-	-	-	-	3	1	-	-	10	-
Lymnaea catascopium	23	40	-	18	16	-	14	21	-	4	-	-	-	11	-
Physa ancillaria	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-
Physa heterostropha	-	-	-	4	5	-	9	2	-	2	1	2	-	4	-
Helisoma anceps	6	6	-	1	18	-	49	33	-	2	-	-	-	8	-
Gyraulus parvus	1	8	-	36	28	-	-	-	-	15	21	20	-	21	-
Promenetus exacuous	-	-	-	2	2	-	-	-	-	3	1	10	-	2	-
Pisidium sp.	+	+	-	-	-	-	-	-	-	-	+	-	-	-	-
Total number of specimens	358			279			231			288			150		

*B = % of total sample at bottom of core *T = % of total sample of dead mollusks at top of core

*L = % of total sample of living mollusks

Table 2. Surficial Sediment Samples

	21		22		23		24		25		26	
	F*	L*	F	L	F	L	F	L	F	L	F	L
Gcniobasis livescens	-	2.3	-	0.6	-	71.0	-	-	-	-	-	10.6
Amnicola lustrica	1.0	6.0	62.1	0.4	1.7	11.3	73.4	-	43.4	2.6	5.3	-
Valvata tricarinata	4.8	-	2.7	11.6	0.8	-	1.1	-	1.1	8.7	5.3	-
Lymnaea humilis	-	-	-	-	-	-	-	-	0.2	-	-	-
Lymnaea catascopium	-	-	0.2	-	-	-	-	-	1.0	-	-	-
Physa ancillaria	-	-	-	-	-	-	-	-	-	-	-	-
Physa heterostropha	0.6	82.3	0.2	2.7	-	13.0	3.6	-	0.2	1.8	42.1	-
Helisoma anceps	-	-	4.1	-	-	-	-	-	0.4	-	26.3	-
Gyraulus parvus	0.6	2.3	10.1	3.7	-	1.8	22.6	-	17.1	21.6	5.3	-
Promenetus exacuous	-	-	-	0.2	-	-	-	-	-	-	-	-
Ferrissia sp.	-	-	-	-	-	-	-	-	-	-	5.3	-
Pisidium sp.	-	-	1.2	0.2	0.4	-	-	-	1.9	-	-	-
Total number of specimens	385		527		238		188		1956		19	

*F = % Sub-fossil specimens in total sample

*L = % Living or recently dead specimens in total sample

Green Lake changed about 150 years ago. The oldest trees living in the flatland are *Thuja occidentalis* L. and *Tsuga canadensis* (L.) Carr. both of which may be found in abundance in swampy environments. The oldest specimen of *T. occidentalis* cored was about 140 years of age and the largest individual *T. canadensis* was about 150 years old. Obviously Green Lake has been at its present level for at least 150 years or the trees could not have grown there. *Thuja occidentalis* may attain an age of 400 years, and *T. canadensis* an age of 600 years (Harlow and Harrar, 1958). Therefore, it is possible that the age of these trees indicates the approximate time that the level of Green Lake was lowered. The outlet of Green Lake was dredged and straightened in conjunction with the building of the original Erie Canal which officially opened in 1825, 145 years ago (Fig. 1). If the excavation of the Green Lake outlet had taken place 5 to 10 years before the opening of the Canal, it is probable that this construction was the cause of the change in surface elevation.

Before the level of the Lake dropped, the marl terraces and the upper surfaces of the bioherms formed rather extensive horizontal littoral areas around the Lake. The dike between Round and Green Lakes was at least one-third covered by water and must have formed a vast area exhibiting conditions optimal for the growth and reproduction of the larger aquatic pulmonates. Since the level of the Lake has receded, these horizontal littoral areas have been almost completely destroyed. At this time, almost all littoral substrates are precipitous and very restricted in area.

Molluscan Fauna

The following species of Gastropoda, formerly abundant in Green Lake, now appear to be extinct: *Helisoma anceps* (Menke), Planorbidæ; *Physa ancillaria* Say, Physidæ, *Lymnæa humilis* Say, and *Lymnæa catascopium* Say; both Lymnæidæ. All of these snails are large (they reach at least lcm in height at maturity) pulmonates. In central New York *H. anceps* is often collected on silt covered bottoms in brooks and on shallow silty lacustrine substrates. Habitats approximating these are restricted to a small area in the neck of the Lake, most of which is too deep into the thermocline to allow for optimal growth during the summer months. Clark Reservation Lake, another nearby meromictic, marl, plunge basin lake which is much like Green, has a very shallow littoral

area supporting a dense population of this species. *Physa ancillaria* appears to be uncommon in central New York and has been replaced by *Physa heterostropha* Say in Green Lake. *Lymnæa humilis* usually occurs on mud flats and other silt covered substrates at the water's surface. This type of habitat is not present in Green Lake. I have found *Lymnæa catascopium* on fine inorganic substrates in rather productive waters from 1 to 5m in depth throughout the Oswego watershed in central New York.

Other species of mollusks now living in the Lake are *Gyraulus parvus* (Say) and *Promenetus exacuous* (Say), both Planorbidæ, *Amnicola lustrica* Pilsbry, Hydrobiidæ, *Valvata tricarinata* (Say), Valvatidæ, and *Pisidium* sp.; Sphæriidæ.

All of the gastropods present are small (5mm or less) species that are common in littoral waters throughout New York State where they often occur abundantly in dense vegetation. In Green Lake they may be found by diligent searching in beds of *Chara* sp. in the shallows. Species of *Pisidium* that occur in lentic environments are normally found in woodland pools on a substrate of deciduous leaves or on silty bottoms in waters of various depths (Herrington, 1962). A few living specimens have been found in Green Lake on soft marl bottoms with a high organic content.

Recently, an operculate gastropod has invaded Green Lake from Chittenango Creek via the outlet stream. In 1935 Eggleton (1956) observed *Goniobasis livescens* (Menke) (Pleuroceridæ) at the extreme north end of the Lake adjacent to the outlet. In 1965 the species was found on the east, west, and north shores of the Lake, (Brunskill and Ludlam, 1967; Harman and Jackson, 1967). *Goniobasis livescens* has not yet advanced to the inlet or to Round Lake.

Conclusions

It is felt that the larger pulmonate snails that are not dependent on oxygen tensions in the water (they are able to utilize atmospheric air) compete better in warm, shallow environments that may be low in oxygen, but high in productivity. Prosobranchs depend upon oxygen in solution in the water and are better able to compete in highly oxygenated habitats even though the nutrient levels may be very low. Small pulmonates are able to exist in either situation because of their ability to respire atmospheric air and because of their surface/volume relationships which are such as to

allow respiration via diffusion of oxygen from the water through epidermal membranes.

Observations indicate that approximately 150 years ago, the dredging of the outlet channel of Green Lake lowered the level of the lake about 1.5m, reducing its surface area and destroying much of the horizontal littoral habitat. The larger pulmonates that were previously favored by the warm, shallow, comparatively productive waters were then forced to compete with prosobranchs and small pulmonates in a cold, oligotrophic habitat that was more optimal for the latter. This has resulted in the local extinction of the larger pulmonate snails in Green Lake.

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A FORGOTTEN PERIODICAL OF WEST AMERICAN CONCHOLOGY

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Research by the authors among the papers and letters of Josiah Keep (1849-1911), now preserved in the library of Mills College, Oakland, California—where Keep was an instructor for many years—has brought to light copies of a publication apparently unmentioned in molluscan literature.

The Conchologist[1] was a typeset pamphlet originating at Alameda, California, edited by Albion Doe, a young student and acquaintance of Keep. Volume 1, Number 1, dated January 1901, identifies the publication as "the official organ of the Isaac Lea Chapter of Conchology [No. 119]" of the Agassiz Association, and bears an *AA* monogram such as used by that Association. *The Conchologist* was distributed free to chapter members and was available to others by subscription, at a cost of 40 cents per year.

The Mills College library possesses one copy each of Numbers 1, 2, and 3 of Volume 1 (January, February, and March, 1901, respectively), which contain six, six, and eight pages. Dating of the issues may be questionable, as the February issue is also imprinted "January", and one page of the March issue is headed "February", but these irregularities look like printers' errors. The copies are in an advanced stage of deterioration and, as we have found, may crumble at a touch. Evidence within *The Conchologist* itself suggests that subsequent numbers may have been issued. The third number is larger than the preceding two. The editor states his intention to publish the contents of a clipping sent to him, and to continue a serialized article in "the May issue".

A search of several journals of the time (including *The Nautilus* and *The West American Scientist*) has failed to reveal any mention of *The Conchologist,* and we have been unable to locate any reference to it among the Keep letters and papers at Mills College. There appear to be no other copies in institutions around

[1] Not to be confused with *The Conchologist: A Quarterly Magazine for Conchologists* (1891), nor *The Conchologist: A Journal of Malacology* (1893), both early names of the British periodical, *The Journal of Malacology,* nor the book, *The Conchologist,* by John C. Warren, Boston, 1834.

San Francisco. Since the chapter's membership roster published in Number 3 lists members in Maryland, Illinois, Florida, and Washington, D. C., as well as in California, it is possible that sets of the periodical may be preserved in other parts of the country.

Content of the journal deals mainly with the mollusks of the San Francisco Bay region; seven of the articles contain reports on the occurrence of various species, native and introduced. An anonymous article records twelve species of mollusks from pilings of the Bay Farm Island Bridge, near the Oakland estuary, Alameda County. Also included are a column of exchange offers, a review of one issue of *The Nautilus,* and an article by Josiah Keep about the study of conchology. No new taxa are proposed.

From Keep's correspondence, it seems apparent that by the late 1890's the Isaac Lea Chapter as originally organized (Leach, 1890, 1894) was losing member support. The very fact that it was a corresponding chapter and, instead of holding meetings, mailed a bound volume of reports from one member to another around the country, may have worked against its survival. It is possible that *The Conchologist* came out of an attempt by Keep to reorganize the chapter among younger enthusiasts in the Oakland-Alameda area. Until the year 1900, the chapter used *The Nautilus* and *Popular Science News* for publication of selected reports.

Photographic copies of the three numbers will be placed in the California Academy of Sciences and other institutions; Mills College retains the originals. We wish to thank Miss Flora Elizabeth Reynolds, Librarian, and Mrs. Mary Manning Cook, Reference Librarian, Mills College, Oakland, for permitting us to examine this publication and allowing copies to be made.

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NOTES

Fluxina Dall is a Calliostoma Swainson.—Dall (1881) erected *Fluxina,* type species *Fluxina brunnea* Dall 1881, and placed it in the Architectonicidæ. Here it has remained, without question, to this day. While studying the Architectonicidæ, I

found that *F. brunnea* possesses the characteristics of *Calliostoma* and is, in fact, already represented in that genus under the name of *C. tejedori* Aguayo 1949. Of course, Aguayo's name must be suppressed in favor of Dall's earlier name. *Calliostoma brunneum* has two major characters that easily separate it from the Architectonicidæ—the protoconch is orthostrophic, and the interior of the aperture is highly iridescent. The correct synonymy follows:

Calliostoma brunneum (DALL)

Fluxina brunnea Dall 1881. Bull. Mus. Comp. Zool., *9* (2) : 52 (type locality, *Blake* sta. 2, off Morro Light, Habana, Cuba, in 805 fms.; type specimen, Museum of Comparative Zoology, no. 7463); Dall 1889. Bull. Mus. Comp. Zool., *18* (12) : 273, pl. 22, figs. 6, 6a.

Calliostoma (*Astele*) *tejedori* Aguayo 1949. Revista de la Sociedad Malacologica "Carlos de la Torre", *6* (3) : 94, pl. 4, fig. 7 (type locality, Arenas de la Chorrera, Habana, Cuba, in 3-15 fms.; type specimen, Muséo Poey, Universidad de la Habana, Cuba, no. 12389 [presently on loan to the Museum of Comparative Zoology]; Clench and Turner 1960. Johnsonia, *4* (40) : 73, pl. 54.

Remarks. The synonymization of *Fluxina* with *Calliostoma* of the Trochidæ is important since it eliminates one of the five genera given by Thiele (1929) and Wenz (1939) for the Architectonicidæ of the western Atlantic.

Clench and Turner (1960) remark that *Calliostoma tejedori* [= *C. brunneum*] is ". . . known only from the holotype specimen which was taken from the pile of construction sand at Habana, Cuba, known as the Arenas de la Chorrera." Since Clench and Turner did not associate their species with Dall's *Fluxina brunnea,* they did not include all locality records. I do so now to complete the known geographic distribution of the species.

Range. From off Cuba to the Barbados in depths of 3-15 to 966 fms.

Specimens examined. **Cuba:** off Habana in 80 fms. (U.S. Nat. Mus.) ; *Blake* sta. 2, off Morro Light, Habana, in 805 fms. (Mus. Comp. Zool.) ; Arenas de la Chorrera, Habana, in 3-15 fms. (Muséo Poey) . **Jamaica:** *Albatross* sta. 2140, So. of Kingston (17°36′10″ N. Lat.; 76°46′05″ W. Long.) in 966 fms. (U.S. Nat. Mus.) . **Barbados:** off Barbados in deep water (U.S. Nat. Mus.) .

—Arthur S. Merrill, U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries Biological Laboratory, Oxford, Maryland 21654

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Malacology in Mainland China.—Little information has been available on the mollusks of mainland China since 1949. During the last 20 years, however, several important items have appeared, some without abstracts in a Western European language.

Recently the Joint Publications Research Service of the Department of Commerce has issued publication "JPRS 45744, Communist Chinese Scientific Abstracts, No. 2," which is available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151, for $3.00. Peters (1969, *Copeia,* no. 1, pp. 214-215) has commented on the herpetological papers and noted that nearly 600 zoological contributions are abstracted in this publication, giving a reasonably broad indication of the status of zoological research in mainland China as of July 1964, when the Conference was held in Peking. Since the Cultural Revolution (1966), even the standard zoological journals of Communist China have ceased publication.

Of the 31 abstracts presented on mollusks, most (14) were contributed by members of the Chinese Academy of Sciences at Peking with various institutes, particularly the Institute of Oceanography, leading the list with 7 titles. About 10 provincial universities and research centers were responsible for the remaining papers. Studies on economically and medically important mollusks seem to dominate: ecology of *Oncomelania* in the Wu-Hu (Lake in Hsin-Chou Hsien, experiments on *Oncomelania* in relation to speed of water flow, seasonal variation in the physiology of *Oncomelania,* embryology of *Parafossarulus,* ecology and reproduction of *Corbicula fluminea,* morphology of *Radix plicatula,* oyster farming and the distribution of *Arca subcrenata* in Liaoning, rates of filter-feeding in 3 bivalves (*Ostrea, Mytilus* and *Chlamys*), and embryology and life history of the estuarine solecurtid *Sinonovacula constricta.*

Several fresh-water surveys were reported, some without abstracts. Thus, over 40 species of fresh-water bivalves and gastropods of the large inland reservoirs and natural lakes Tung-t'ing Hu, [Hunan] P'u—Yang Hu [Poyang Hu, Kiangsi], Tung Hu of Wu—Ch'ang, and Hua-ma Hu of Hupeh are delineated. There are also reviews of the fresh-water bivalves of the Chunking Area and the economically important species in the T'ai-yuan Area, Shansi. Some 21 species of pulmonates of Kwangtung and Hainan are listed but this is a very incomplete list [with only 1 succineid, 2 subulinids, 6 ariophantids, 4 pleurodontids, 1 achatinid, 3 fruticicolids, 2 streptaxids and 1 philomycid!!].

At least 7 papers deal with the marine mollusks of the inshore waters of coastal China. Species of the bivalve families Pteriidæ (16 species), Chamidæ (9 species) and Nuculanidæ (13 species) are reviewed. Of neogastropods, 5 *Murex,* 1 *Pterynotus,* 7 *Chicoreus* and 20 *Drupa* are listed. Seven species of pleurobranchids are discussed. Some 32 species of cephalopods from Fukien are reviewed and data on catch-statistics and local distribution presented.

Several papers abstracted here appeared in a complete form in *Acta Zoologica Sinica* (Vols. 14-17), particularly the surveys of the fresh-water lakes by the Institute of Zoology and the two most distinguished malacologists, Hsi Chang (sometimes rendered Si Tchang) and Yueh-ying Liu. Additionally several groups of marine mollusks (aplysiids, pinnids, venerids, cardiids, olivids, teredinids, muricids, tellinaceans, cephalopods, janthinids, pteropods and heteropods) have received monographic treatment in *Studia Marina Sinica,* (vols. 1-8) issued by the Institute of Oceanography. K. J. Boss, Mus. Comp. Zool., Cambridge, Mass. 02138.

LITTORINA IN LOUISIANA.—Three species of *Littorina,* none of them previously reported from Louisiana, were found on jetties during the summer of 1960. *Littorina irrorata* (Say), a characteristic saltmarsh species of the northern Gulf coast, is also found on jetties. The specimens are deposited in the Tulane University Invertebrate Collections. *Littorina angulifera* (Lamarck, 1822). Grand Isle, Jefferson Parish, La., east end near Barataria Pass; 25 Aug. 1960. *Littorina nebulosa* (Lamarck, 1822). Same locality and date. *Littorina ziczac* (Gmelin, 1790). Mouth of Bayou LaFourche,

LaFourche Parish, La.; 28 July 1960. The distributions of these snails is discussed by Hedgpeth (Publ. Inst. Mar. Sci., 3 (1) : 111-224, 1953) and Bingham (Nautilus, *82* (4) : 146-147, 1969).—Alfred E. Smalley, Dept. Biol., Tulane Univ., New Orleans, La. 70118.

Corbicula manilensis (Philippi) in Lower Florida.—R. F. Schneider (1967, Nautilus *81:* 68) has reported upon this Asiatic clam in northern Florida (as *C. fluminea* Müller (= *manilensis*)) from the Escambia River, near Century, Escambia Co., to the Withlacoochee River, Inglis, Levy Co. (not the different Withlacoochee River, Madison Co., an important confluent of the Suwannee River). My thanks are due to Mrs. Muriel E. Hunter of Pinellas Park, Florida, for a series of *C. manilensis* from Lake Hicpochee, Caloosahatchee River Canal, collected in 1969. This extension into the Caloosahatchee-Lake Okeechobee System will lead to its distribution all over the lower Florida peninsula.

The rapid spread of this species, from its first known record in 1938 from the lower Columbia River in Washington to the Caloosahatchee-Lake Okeechobee system in lower Florida in 1969, is unique in the history of fresh-water molluscan dispersal in North America. It is possible that this little fresh-water clam may be able to pass through the intestinal tract of aquatic birds in a viable condition and thus enable it to pass from one river system to another, sometimes over fairly long distances.—William J. Clench, Mus. Comp. Zool., Cambridge, Mass. 02138.

Dates of the Nautilus.—Vol. 83, No. 1 mailed July 28, 1969. No. 2, Oct. 31. No. 3, Jan. 23, 1970. No. 4, April 30.

A Newsletter, entitled Achatina, is to be issued in the spring of 1970, dealing with the land and fresh-water mollusks of Africa, Madagascar and adjacent islands. It will give names and addresses of persons interested in this area, notes concerning current research, proposed expeditions, and bibliographies. Interested research workers may write Dr. J.-J. Van Mol, Zoologie Systématique, Univ. Libre de Bruxelles, 50 Avenue F. D. Roosevelt, Bruxelles, Belgium.

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THE NAUTILUS

THE PILSBRY QUARTERLY

DEVOTED TO THE INTERESTS OF CONCHOLOGISTS

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THE NAUTILUS

Vol. 84 October, 1970 No. 2

LEO GEORGE HERTLEIN HONOR ISSUE

By his friends

We are particularly indebted to Dr. R. Tucker Abbott, one of the editors and publishers of *The Nautilus,* for permitting us to devote a number of this journal in honor of Dr. Leo G. Hertlein. William K. Emerson of the American Museum of Natural History contacted some of the many friends of Dr. Hertlein for scientific contributions in his honor. The response to this soliciting was extremely good. David Nicol of the University of Florida, and his wife Helen V. Nicol, collated and did some of the editing of the manuscripts. We believe we can speak for all when we say that it is a great pleasure to pay tribute to a man who has willingly done so much for others.

Not all of the manuscripts honoring Dr. Hertlein can be published in one number of *The Nautilus.* For this reason we list here the contributions to appear in the next issue honoring our esteemed friend:

Cadulus (*Gadila*) *perpusillus* (Sowerby, 1832), an earlier name for *C. (G.) panamensis* Sharp and Pilsbry, 1898, by William K. Emerson.

The ecological significance of *Thyasira bisecta* Conrad, by Saburo Kanno.

New record for a rare Galapágos land snail, by Allyn G. Smith.

BIOGRAPHICAL SKETCH OF LEO HERTLEIN[1]

By warren o. addicott
U.S. Geological Survey, Menlo Park, California 94025

Leo George Hertlein, the youngest of four children, was born in 1898 on a farm in Pratt County, Kansas. Although his family moved to Wichita when he was 10 years of age, Leo continued to spend summers on the farm. He attended public schools in Kansas,

[1] Based in part upon an anonymous "Biographical sketch [of] Leo G. Hertlein" in the Conchological Club of Southern California Bull., v. 4, no. 5, p. S17-S19, 1963.

graduating from Wichita High School in 1916. After graduation, he spent a year working in the city before heading west to visit a sister in Idaho. This trip eventually took him to the Pacific coast where he enrolled in the University of Oregon. Electing to major in geology, his introduction to paleontology was in a course given by Dr. Katherine Van Winkle Palmer. He took additional course work in paleontology under Dr. Earl L. Packard, a gifted teacher who produced many other well-known paleontologists (including H. G. Schenck, H. V. Howe, Siemon Muller, and Orville Bandy). While at the University, Leo took out part of a year for a brief stint in the merchant marine. His summers were spent in a variety of occupations: as a commercial fisherman on a purse seiner in Alaskan waters and in the Columbia River, as a member of a timber-surveying party in western Washington, and working in a copper mine. He received a B.A. degree in geology from the University in 1922.

Leo continued his interest in geology and paleontology at Stanford University where he enrolled as a graduate student in the Department of Geology. As a paleontology major he became a student of Dr. J. P. Smith, a famous and inspirational professor who taught many other prominent molluscan paleontologists, including Ralph Arnold, F. M. Anderson, and U. S. Grant, IV. He received an M.A. in 1923 and a Ph.D. in 1929; his doctoral dissertation was on Pliocene geology and paleontology of the San Diego area, California.

Following completion of formal schooling at Stanford, he held temporary appointments as paleontologist with the Associated and Pacific Oil Companies in San Francisco, and later, with the California Academy of Sciences, as an assistant in the Department of Paleontology. In 1926 he was appointed Assistant Curator in the Department of Paleontology at the Academy, which proved to be the beginning of a long and very productive association that has continued to the present time. At the Academy he became associated with Dr. G. Dallas Hanna, a relationship that has produced many joint reports on fossil and living mollusks of the eastern Pacific. In his first years at the Academy, a warm friendship with Eric Knight Jordan developed, resulting in a field trip to northern Baja California, Mexico, and in the subsequent publication of several important papers on the paleontology of Baja California.

During a leave of absence from the Academy in 1926 he served as paleontologist with the Henry L. Doherty Mexican Government Concession, working out of Saltillo, Mexico. In 1929, again on leave from the Academy, he was employed as field geologist for the Hudson's Bay Marland Oil Company, and similarly in 1930 for the Hudson's Bay Oil and Gas Company in Alberta, Canada.

In 1927 he led an Academy field party to the Channel Islands off southern California. Soon thereafter, he initiated a cooperative study of the geology and paleontology of the marine Pliocene rocks of southwestern San Diego County, California, with U. S. Grant, IV. This investigation continued during several succeeding field seasons and has been a principal focus of Hertlein's research over the years. Two parts of this monographic study have been published, and a third, dealing with the Pelecypoda, will soon be in press. The Hertlein and Grant association has been productive of many other significant paleontologic contributions, notably catalogues of Pacific coast Cenozoic Brachiopoda and of Echinoidea.

During the winter of 1931-32, Hertlein was a member of the expedition of the VELERO III to the tropical eastern Pacific. As a result of this cruise, he made extensive collections of invertebrates from the Galápagos Islands and from nearshore areas along the Mexican and Central American coasts. At the request of William Beebe, Hertlein and A. M. Strong worked up the vast molluscan collections from the eastern Pacific obtained in the period 1936-38 by the Templeton Crocker and Zaca expeditions of the New York Zoological Society. This led to a period of intensive collaborative study of the molluscan faunas of the tropical eastern Pacific; all told, more than 230 new molluscan taxa were described in a series of joint publications extending from the 1930's into the mid-1950's.

Interspersed with his current research on the San Diego Pliocene has been his continuing descriptive study of fossil and living mollusks and echinoids from the eastern Pacific Ocean. As one of the world's leading authorities on monomyarian pelecypods, particularly the Pectinidae, he has contributed significantly to the Bivalvia volume of the Treatise on Invertebrate Paleontology.

In 1949 he became Associate Curator in the Department of Paleontology at the California Academy of Sciences; in 1962 he was appointed Curator of Invertebrate Paleontology. He also has held

Leo G. Hertlein

an appointment, since 1953, as geologist (WAE) with the U.S. Geological Survey. A member of the American Malacological Union since its founding, Leo has served as vice-president (1965-66) and president (1966-67), and was elected to Honorary Life Membership in July 1970. In 1968 he was the recipient of a special award, "in recognition of outstanding contributions to the study of Mollusca," from the Pacific Division of the American Malacological Union. Hertlein was made a Life Member of the California

Academy of Sciences in 1941; he was elected a Fellow in 1952. He formally retired in mid-1969 but actively pursues his molluscan studies as Curator Emeritus in the Academy's Department of Geology.

Hertlein's bibliography includes about 150 titles. In these are found descriptions of almost 500 new invertebrate taxa. His fundamental contributions to Cenozoic invertebrate paleontology (mollusks, echinoids, brachiopods) of the Pacific Coast states and Mexico and to the knowledge of modern molluscan fauna of the eastern Pacific are widely known and recognized. Perhaps equally important, but not so well known, are his countless contributions to paleontological, geological, malacological, and even archaeological reports by others—in the form of lists of invertebrates, age determinations, and faunal correlations. Among his unsung contributions may also be listed his many contacts with young paleontologists and malacologists who have benefited from his untiring help and enthusiastic encouragement with their research projects.

Hertlein's publications stand as models of thorough and painstaking scientific investigation, special qualities that have characterized all aspects of his scientific career. The high quality of his reports, at once obvious to anyone who has had occasion to refer to them, is the result of meticulous searching of all pertinent literature, and, wherever possible, solicitation and careful weighing of the views of associates.

As a curator, his high standards are clearly reflected by the expertly and meticously maintained invertebrate type collections in the Academy's Department of Geology as well as by the carefully arranged and labeled general collections of fossil and living invertebrates.

Leo lives in San Francisco with his wife, Margaret, a teacher of speech and dramatics in the Adult Education Division of the San Francisco School System, whom he married in 1940. During leisure time, they enjoy music, literature, and the theatre. Their vacations often consist of visits to various national and state parks. Leo is an avid sports fan, particularly interested in professional football. As a hobby he is accumulating information on coloration in nature.

TAXA PROPOSED IN HONOR OF LEO GEORGE HERTLEIN FROM 1926 TO 1969

Compiled by Barry Roth and others

Turbonilla (*Pyrgiscus*) *hertleini* Jordan, 1926
Coscinodiscus hertleini Hanna & Grant, 1926 (diatom)
Triceratium hertleini Hanna, 1927 (diatom)
Pteria hertleini Wiedey, 1928
Pecten (*Chlamys*) *hertleini* Loel & Corey, 1932
Fusinus hertleini Lowe, 1935
Helminthoglypta hertleini Hanna & Smith, 1937
Odostomia (*Salassia*) *hertleini* Strong, 1938
Exilioidea rectrostris hertleini Bentson, 1940
Flabellum hertleini Durham, 1942 (coral)
Leptastrea hertleini Durham, 1942 (coral)
Suavodrillia hertleini Durham, 1944
Cypraea hertleini Ingram, 1948
Rissoella hertleini Smith & Gordon, 1948
Hertleinia Marks, 1949, not *Hertleinia* Imlay, 1957
Basterotia hertleini Durham, 1950
Semele hertleini Durham, 1950
Lyrodes hertleini Drake, 1956
Ensitellops hertleini Emerson & Puffer, 1957
Hertleinella Berry, 1958
Hertleinites Imlay, 1958, new name for *Hertleinia* Imlay, 1957, not Marks, 1949
Hertellina Olsson, 1961 (mollusk)
Eurytellina (*Eurytellina*) *hertleini* Olsson, 1961
Pitar (*Hyphantosoma*) *hertleini* Olsson, 1961
Polygyra (*Erymodon*) *hertleini* Haas, 1961
Gabbioceras hertleini Wiedmann, 1962
Lima (*Acesta*) *hertleini* Olsson, 1964
Sthenorytis hertleini Olsson, 1964
Boetica hertleini Kanakoff, 1966
Leochlamys MacNeil, 1967
Cetolepas hertleini Zullo, 1969 (barnacle)
Hindsiclava hertleini Emerson & Radwin, 1969
Ostrea hertleini Adegoke, 1969

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NAMES PROPOSED BY LEO GEORGE HERTLEIN FROM 1925 TO 1970

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Each entry in this alphabetical list contains (1) the taxon as originally proposed, (2) the authors' names, where authorship was shared by Hertlein and another worker, and (3) the original reference, correlating with the bibliography of Hertlein's works which appears in this issue of *The Nautilus*. For example, "1944a" refers to the first title listed in the bibliography under 1944, "1944b" refers to the second title under that year, and so forth.

abietis Jordan & Hertlein, *Pecten (Plagioctenium)* 1926b: p. 214, pl. 23, figs. 1, 3, 7.

academica Strong & Hertlein, *Turbonilla (Cingulina)* 1939d: p. 205, pl. 19, fig. 14.

Acanthotrophon Hertlein & Strong 1951f: p. 86. Type-species by original designation: *Trophon (Acanthotrophon) sorenseni* Hertlein & Strong.

aguerreverei Hanna & Hertlein, *Holospira* 1929d: p. 219, pl. 24, figs. 5, 6.
alarconi Hertlein & Strong, *Rissoina* 1951f: p. 109, pl. 8, fig. 12.
aletes, Pecten (Pecten) 1925b: p. 8, pl. 2, figs. 1, 2 .
aletes Hertlein & Strong, *Pitar (Hyphantosoma)* 1948b: p. 172, pl. 1, figs. 9, 11-13.
alexi Hertlein & Grant, *Eohemithiris* 1944a: p. 55, pl. 3, figs. 4, 7-9; text fig. 10.
allyneana Hertlein & Hanna, *Mytilopsis* 1949c: p. 14, pl. 4, figs. 5-8.
allyniana Hertlein & Strong, *Cymatosyrinx* 1951f: p. 77, pl. 1, fig. 7.
amandi, Pecten (Chlamys) 1935b: p. 305: new name for *Pecten australis* Philippi, 1845, not Sowerby, 1842.
amandi Strong & Hertlein, *Turbonilla (Pyrgiscus)* 1939d: p. 202, pl. 19, fig. 7.
amandusi Hertlein & Jordan, *Cypraea* 1927a: p. 628, pl. 18, fig. 1; pl. 19, figs. 1, 4, 5.
amiriana Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 94, pl. 6, fig. 7.
Anatipopecten 1936c: p. 26. Type-species by original designation: *Pecten anatipes* Morton.
angermanni Hertlein & Jordan, *Ostrea* 1927a: p. 621, pl. 17, figs. 3, 6.
arenaense Hertlein & Strong, *Bittium (Lirobittium)* 1951f: p. 107, pl. 7, fig. 8.
arenensis Hertlein & Strong, *Cymatosyrinx* 1951f: p. 76, pl. 1, fig. 17.
arenica Hertlein & Strong, *Tellina (Moerella)* 1949d: p. 68, pl. 1, figs. 5, 11.
armstrongi Hertlein & Strong, *Lioglyphostoma* 1955b: p. 230, pl. 3, fig. 12.
arnoldi Hertlein & Grant, *Terebratalia* 1944a: p. 119, pl. 11, figs. 1-3, 10-15.
asaedai Hertlein & Strong, *Cymatosyrinx* 1951f: p. 78, pl. 1, fig. 4.
ashleyi, Ostrea 1934a: p. 1, pl. 1, figs. 2, 3; pl. 2, fig. 1.
askoyana Hertlein & Strong, *Tellina (Eurytellina)* 1955b: p. 197, pl. 3, figs. 3, 13-15, 20, 21, 23.
atollica Hertlein & Allison, *Succinea* 1968f: p. 10, fig. 11.
augustinensis, Calliostoma 1928b: p. 154, pl. 25, figs. 4, 5.
axeliana Hertlein & Strong, *Rissoina* 1951f: p. 109, pl. 3, fig. 6.
ayamana Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 96, pl. 6, fig. 14.
azteca Strong & Hertlein, *Odostomia (Miralda)* 1939d: p. 207, pl. 18, fig. 10.
bahiahondaense Strong & Hertlein, *Caecum* 1939d: p. 219, pl. 20, fig. 10.
bailyi Hertlein & Strong, *Circulus* 1951f: p. 111, pl. 9, figs. 2, 6, 9.
bakeri Hertlein & Strong, *Aspella* 1951d: p. 79, pl. 26, figs. 1, 2.

bakeri Strong & Hertlein, *Circulus* 1939d: p. 240, pl. 21, figs. 14, 15; pl. 22, fig. 1.
bakeri Hanna & Hertlein, *Pecten (Patinopecten)* 1927b: p. 153, pl. 5, fig. 1.
balboai Strong & Hertlein, *Liotia* 1939d: p. 236, pl. 21, figs. 3, 5, 6.
ballenaensis Hertlein & Strong, *Crassispira turricula* 1951f: p. 73, pl. 11, figs. 4, 11.
barbati Hanna & Hertlein, *Cerithium* 1938d: p. 108, pl. 21, figs. 7-9.
bartschi Strong & Hertlein, *Cyclostrema* 1939d: p. 240, pl. 21, figs. 12, 13, 16.
bartschi Strong & Hertlein, *Eulimostraca* 1937d: p. 170, pl. 35, fig. 7.
bartonella Strong & Hertlein, *Turbonilla (Pyrgiscus)* 1939d: p. 203, pl. 19, fig. 8.
baughmani, Anadara 1951a: p. 487, figs. 1-7.
beali, Pecten (Pecten) 1925b: p. 10, pl. 2, fig. 3; pl. 5, fig. 8.
Bechtelia Emerson & Hertlein 1964f: p. 360. Type-species by original designation: *Gyrineum strongi* Jordan.
beebei, Cardita spurca 1958a: p. 107, pl. 21, figs. 3, 4, 12-14.
beebei Hertlein & Strong, *Fissurella* 1951f: p. 113, pl. 10, figs. 3-5.
beebei Hertlein & Strong, *Trophon (Boreotrophon)* 1947b: p. 80, pl. 18, figs. 1, 2.
beltiana Hertlein & Strong, *Turbonilla (Careliopsis)* 1951f: p. 91, pl. 6, fig. 3.
biolleyi Hertlein & Strong, *Pecten (Leptopecten) velero* 1946a: p. 60, pl. 1, fig. 6.
biolleyi Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 98, pl. 3, fig. 2.
blanpiedi Grant & Hertlein, *Brissopsis* 1938b: p. 484, figs. 5, 6, 8-10.
bonita Strong, Hanna & Hertlein, *Calliostoma* 1933e: p. 121, pl. 5, figs. 5, 6.
bonita Strong & Hertlein, *Strombina* 1937d: p. 169, pl. 35, fig. 9.
bösei Hanna & Hertlein, *Pecten (Pecten)* 1927b: p. 154, pl. 5, figs. 2, 3.
bösei Hertlein & Jordan, *Turritella* 1927a: p. 634, pl. 21, figs. 1, 2.
bourgeoisae, Tagelus (Mesopleura) 1951b: p. 73, pl. 26, figs. 5, 6.
bristolae Hertlein & Strong, *Calotrophon* 1951f: p. 87, pl. 2, fig. 2.
brujae Hertlein & Strong, *Crassispira* 1951f: p. 74, pl. 1, fig. 18.
burchi Hertlein & Strong, *Cytharella* 1951f: p. 79, pl. 1, fig. 6.
burckhardti Hertlein & Jordan, *Terebra* 1927a: p. 632, pl. 21, fig. 6.
burgeri Grant & Hertlein, *Echinoneus* 1938c: p. 104, pl. 22, figs. 1-3, 6; pl. 23, figs. 6, 7.
calli, Pecten (Plagioctenium) 1925b: p. 16, pl. 4, figs. 5-7.
callidus, Pecten (Plagioctenium) 1925b: p. 22, pl. 5, figs. 1, 3, 5, 6.

Calotrophon Hertlein & Strong 1951f: p. 87. Type-species by original designation: *Calotrophon bristolae* Hertlein & Strong.
cambodicus, Pecten 1936c: p. 56; new name for *Pecten fimbriatus* Mansuy, 1912, not Philippi, 1844, nor Moore, 1870.
caneloensis Hertlein & Strong, *Natica* 1955b: p. 287, pl. 2, figs. 13, 18.
caneloensis Hertlein & Strong, *Odostomia (Besla)* 1951f: p. 102, pl. 7, fig. 3.
casseli Grant & Hertlein, *Dendraster* 1938c: p. 81, pl. 1, figs. 1-3; pl. 30, fig. 3.
cedrosense Hertlein & Strong, *Dentalium (Rhabdus)* 1951f: p. 69, pl. 11, fig. 9.
cedrosensis Jordan & Hertlein, *Epitonium* 1926a: p. 446, pl. 30, fig. 3.
chacei Hertlein & Strong, *Crassispira* 1951f: p. 73, pl. 1, fig. 12.
chinandegana Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 97, pl. 5, fig. 3.
chiquita Hertlein & Strong, *Hemitoma* 1951f: p. 113, pl. 10, figs. 2, 7, 10.
cholutecana Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 97, pl. 5, fig. 5.
churchi, Alectrion 1928b: p. 156, pl. 22, fig. 1.
clarionense Hertlein & Strong, *Cardium (Laevicardium)* 1947a: p. 144, pl. 1, figs. 5-7, 14.
clarionensis Hertlein & Strong, *Ctena* 1946b: p. 118, pl. 1, figs. 11, 12, 14.
clarionensis Hertlein & Strong, *Turritella* 1951f: p. 108, pl. 2, fig. 13.
clippertonensis Hertlein & Emerson, *Clanculus (Panocochlea)* 1953b: p. 354, pl. 27, figs. 19, 20, 22.
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colima Strong & Hertlein, *Natica* 1937d: p. 174, pl. 35, figs. 12, 13, 16.
colimana Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 94, pl. 6, fig. 5.
colimanum Hertlein & Strong, *Epitonium (Punctiscala?)* 1951f: p. 90, pl. 3, fig. 14.
condoni, Pecten (Amusium) 1925a: p. 41, pl. 4, figs. 8, 9.
Condonia 1965a: p. 1. Type-species by original designation: *Sistrum hannai* Howe.
contrerasi Jordan & Hertlein, *Epitonium* 1926a: p. 446, pl. 30, fig. 4.
contrerasiana Hertlein & Strong, *Turbonilla (Strioturbonilla)* 1951f: p. 102, pl. 5, fig. 13.
cooperella Hertlein & Grant, *Cyclothyris* 1944a: p. 63; new name

Waldheimia imbricata Cooper, 1894, not Tenison-Woods, 1865.
coreyi Grant & Hertlein, *Lytechinus* 1938c: p. 24, pl. 20, fig. 7.
coreyi Hertlein & Grant, *Terebratula* 1944a: p. 87, pl. 4, figs. 12-16; text fig. 21.
corintoensis Hertlein & Strong, *Odostomia (Chrysallida)* 1951f: p. 104, pl. 8, fig. 11.
corintonis Hertlein & Strong, *Balcis (Balcis)* 1951f: p. 90, pl. 6, fig. 1.
corintonis Hertlein & Strong, *Turbonilla (Strioturbonilla)* 1951f: p. 101, pl. 4, fig. 1.
corteziensis, Ostrea 1951b: p. 68, pl. 24, figs. 1, 2; pl. 26, fig. 7.
costaricensis Hertlein & Strong, *Odostomia (Chrysallida)* 1951f: p. 103, pl. 7, fig. 9.
Costelloleda Hertlein & Strong 1940b: p. 398. Type-species by original designation: *Nucula costellata* Sowerby.
cowlesi Strong & Hertlein, *Turbonilla (Strioturbonilla)* 1939d: p. 196, pl. 19, fig. 3.
craneana Hertlein & Strong, *Elaeocyma* 1951f: p. 75, pl. 1, fig. 2.
craneana Hertlein & Strong, *Semele* 1949e: p. 241, pl. 1, figs. 19, 22.
crickmayi Palmer & Hertlein, *Polinices* 1936d: p. 77, pl. 19, figs. 12, 14.
crickmayi Strong & Hertlein, *Turbonilla (Pyrgiscus)* 1939d: p. 200, pl. 19, fig. 10.
cristobalensis, Pecten (Plagioctenium) 1925b: p. 19, pl. 3, figs. 1, 2, 5.
Crockerella Hertlein & Strong 1951f: p. 78. Type-species by original designation: *Clathurella crystallina* Gabb.
crockeri Strong & Hertlein, *Cardium (Papyridea)* 1937d: p. 161, pl. 34, figs. 1, 2, 7, 10.
crockeri Hertlein & Strong, *Solen* 1950c: p. 225, pl. 1, figs. 3, 5, 7.
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dallasi Jordan & Hertlein, *Epitonium* 1926a: p. 447, pl. 30, fig. 2.
dallasi Jordan & Hertlein, *Pecten (Chlamys)* 1926b: p. 213, pl. 23, figs. 2, 5, 6, 8.
das-guptai, Pecten (Chlamys) tauroperstriata var. 1936c: p. 55; new name for *Chlamys tauroperstriata* var. *spinosa* Das-Gupta, 1924, not *Pecten spinosus* Brown, 1827.
Dendopecten 1936c: p. 26. Type-species by original designation: *Pecten dendyi* Hutton.
dibbleei Hertlein & Grant, *Hemithiris* 1944a: p. 46, figs. 5, 6.
diegensis Hertlein & Grant, *Laqueus vancouveriensis* 1960e: p. 97, pl. 20, figs. 4, 8-21.
dilloni Hanna & Hertlein, *Campanilopa* 1949f: p. 393, pl. 77, figs. 2, 4; text fig. 1.
diminutivus Hertlein & Jordan, *Pecten (Plagioctenium)* 1927a: p. 623.

domingana Hertlein & Strong, *Turbonilla* (*Pyrigiscus*) 1951f: p. 93, pl. 6, fig. 6.
drangai Hertlein & Strong, *Balcis (Vitreolina)* 1951f: p. 91, pl. 6, fig. 2.
dumbauldi Hanna & Hertlein, *Terebra* 1961f: p. 77, pl. 6, fig. 2; pl. 7, figs. 2, 5.
durhami Hanna & Hertlein, *Segmentina* 1938d: p. 109, pl. 21, figs. 3-5.
durhamianum Hertlein & Strong, *Epitonium (Nitidiscala)* 1951f: p. 89, pl. 3, fig. 9.
eiseni Strong & Hertlein, *Cerithiopsis* 1939d: p. 216, pl. 20, fig. 6.
eiseni Strong & Hertlein, *Modiolus* 1937d: p. 160, pl. 34, figs. 11, 14-16.
ekidana Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 99, pl. 4, fig. 8.
emersoni Hertlein & Allison, *Acanthina* 1959b: p. 22, pl. 8, fig. 1.
englekyi, Ostrea 1928b: p. 143, pl. 25, fig. 1.
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Eogryphus Hertlein & Grant 1944a: p. 88. Type-species by original designation: *Eogryphus tolmani* Hertlein & Grant.
Eohemithiris Hertlein & Grant 1944a: p. 55. Type-species by original designation: *Eohemithiris alexi* Hertlein & Grant.
ericana Hertlein & Strong, *Crassispira* 1951f: p. 74, pl. 1, fig. 11.
ericana Hertlein & Strong, *Rissoina (Folinia)* 1951f: p. 109, pl. 8, fig. 10.
ericellus, Pecten (Plagioctenium) 1929b: p. 215, pl. 24, figs. 10, 11.
erici Strong & Hertlein, *Liotia* 1939d: p. 237, pl. 21, fig. 9.
erici, Ostrea 1929c: p. 295.
erminiana Hertlein & Strong, *Clathurella* 1951f: p. 71, pl. 1, fig. 8.
etchegoini Hertlein & Grant, *Terebratalia arnoldi* 1944a: p. 122, pl. 10, figs. 5, 9-11.
eucorrugata, Ostrea titan 1934a: p. 5; new name for *Ostrea titan corrugata* Nomland, 1917, not *O. corrugata* Brocchi, 1814, nor. *O. corrugata* Hutton, 1873.
evermanni Jordan & Hertlein, *Pecten (Plagioctenium)* 1926a: p. 439 pl. 27, fig. 1.
fayae, Acmaea turveri 1958a: p. 112, pl. 21, figs. 5-7.
fernandezensis Hertlein & Strong, *Arca (Arca)* 1943b: p. 154; new name for *Arca angulata* King & Broderip, 1832, not Meuschen, 1787.
fernandoensis, Pecten (Pseudamusium) vancouverensis 1925a: p. 43, pl. 4, figs. 6, 7.
fonsecana Hertlein & Strong, *Mactra (Micromactra)* 1950c: p. 232, pl. 2, figs. 16, 19, 20.
freudenbergi Hertlein & Jordan, *Ostrea* 1927a: p. 622, pl. 17, fig. 9; pl. 18, fig. 4.
frizzelli Hertlein & Strong, *Pitar (Lamelliconcha)* 1948b: p. 176, pl. 1, figs. 1, 5, 7; pl. 2, fig. 11.

galapagana Hertlein & Strong, *Transennella* 1939b: p. 378, pl. 32, figs. 1-3, 6, 7.
galapagana Hertlein & Strong, *Vanikoro* 1951f: p. 110, pl. 11, figs. 7, 8.
gallegosi Strong & Hertlein, *Nassarius* 1937d: p. 166, pl. 35, fig. 11.
gallegosi, Odostomia (Jordaniella) 1934b: p. 67, pl. 21, fig. 3.
gallegosi, Jordan & Hertlein, *Pecten (Lyropecten)* 1926a: p. 434, pl. 29, fig. 1.
gallegosiana Hertlein & Strong, *Odostomia (Evalea)* 1951f: p. 104, pl. 8, fig. 1.
garthi Strong & Hertlein, *Turbonilla (Pyrgiscus)* 1939d: p. 199, pl. 19, fig. 9.
gissleri Strong & Hertlein, *Cerithiopsis* 1939d: p. 216, pl. 20, fig. 7.
gissleri Strong & Hertlein, *Epitonium (Nitidiscala)* 1939d: p. 194, pl. 18, fig. 8.
gordana Hertlein & Strong, *Cyclostrema* 1951f: p. 110, pl. 9, figs. 3, 4, 7.
gordanus Hertlein & Strong, *Nassarius insculptus* 1951f: p. 81, pl. 8, fig. 6.
gordoniana Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 99, pl. 5, fig. 1.
granti, Placunanomia 1928b: p. 148, pl. 23, figs. 7-9.
greenellum Hanna & Hertlein, *Campanile* 1939c: p. 101, fig. 1.
grewingki, Chlamys mediacostata 1966a: p. 276, fig. 12.
grossaforma, Cucullaea 1929c: p. 296; new name for *Cucullaea ponderosa* Whiteaves, 1900, not Hutton, 1873.
gruberi Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 100, pl. 4, fig. 3.
grunskyi, Pecten (Chlamys) 1929c: p. 296.
guanacastense Hertlein & Strong, *Cardium (Americardia)* 1947a: p. 140.
guanacastensis Hertlein & Strong, *Cerithiopsis* 1951f: p. 106, pl. 7, fig. 10.
guanacastensis Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 97, pl. 5, fig. 11.
guatulcoensis Hertlein & Strong, *Cerithiopsis* 1951f: p. 106, pl. 7, fig. 7.
guatulcoensis Hertlein & Strong, *Chione (Chione)* 1948b: p. 182, pl. 1, figs. 2, 4, 6, 10; pl. 2, figs. 1, 8, 12, 13.
guatulcoensis Hertlein & Strong, *Odostomia (Chrysallida)* 1951f: p. 103, pl. 7, fig. 2.
guatulcoensis Hertlein & Strong, *Turbonilla (Mormula)* 1951f: p. 92, pl. 6, fig. 9.
guerreroensis Strong & Hertlein, *Anachis* 1937d: p. 169, pl. 35, fig. 4.
haasi Hertlein & Strong, *Mactra (Micromactra) macescens* 1950c: p. 231; new name for *Mactra (Micromactra) macescens* var.

elongata Haas, 1942, not *Mactra elongata* Quoy & Gaimard, 1835.
hakei, Pecten (Plagioctenium) 1925b: p. 18, pl. 4, figs. 1, 3.
haleyi, Ostrea 1933b: p. 277, pl. 18, figs. 5, 6.
haleyi Strong & Hertlein, *Turbonilla (Strioturbonilla)* 1939d: p. 198, pl. 19, fig. 2.
hambachi Strong & Hertlein, *Delphinoidea* 1939d: p. 243, pl. 22, figs. 8-10.
hambachi, Ocenebra sloati 1958a: p. 109, pl. 21, figs. 10, 11.
hancocki Hertlein & Strong, *"Mangelia"* 1939b: p. 375, pl. 32, fig. 9.
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hannai Grant & Hertlein, *Paleoechinoneus* 1938c: p. 105, pl. 23, figs. 4, 5.
hannana Hertlein & Strong, *Anachis coronata* 1951f: p. 82, pl. 2, fig. 3.
hannibali Hertlein & Jordan, *Calliostoma* 1927a: p. 626, pl. 21, figs. 8, 9.
hannibali, Chrysodomus 1925a: p. 42, pl. 4, fig. 4.
hannibali Hertlein & Grant, *Discinisca cumingii* 1944a: p. 29, pl. 16, figs. 7, 8, 11.
hannibali Jordan & Hertlein, *Placunanomia* 1926a: p. 443, pl. 28, figs. 2-4.
harfordi Strong & Hertlein, *Mitrella* 1937d: p. 167, pl. 35, fig. 15.
hartmanni Hertlein & Jordan, *Macron* 1927a: p. 629, pl. 18, fig. 2; pl. 21, fig. 5.
hartmanni, Pecten (Pecten) 1925b: p. 8, pl. 1, figs. 4, 6.
hawleyi, Pecten (Pecten) 1925a: p. 40, pl. 4, figs. 4, 5.
healeyi Strong & Hertlein, *Strombiformis* 1939d: p. 195, pl. 18, fig. 7.
heimi Hertlein & Jordan, *Cymia* 1927a: p. 627, pl. 18, fig. 5.
heimi Strong & Hertlein, *Liotia* 1939d: p. 238, pl. 21, figs. 4, 7.
heimi, Pecten (Pecten) 1925b: p. 9, pl. 1, fig. 3; pl. 3, fig. 3.
hemphilli Hertlein & Strong, *Latirus* 1951f: p. 79, pl. 2, fig. 4.
hemphilli Hertlein & Strong, *Lima (Limaria)* 1946a: p. 66, pl. 1, figs. 3, 4.
hemphilli Strong & Hertlein, *Teinostoma* 1939d: p. 244, pl. 23, figs. 5, 8, 11.
herbertiana Hertlein & Strong, *Teinostoma* 1951f: p. 112, pl. 9, figs. 8, 11, 12.
hewitti Hanna & Hertlein, *Ampullella* 1949f: p. 393, pl. 77, figs. 1, 3; text fig. 2.
hilli Hertlein & Strong, *Crockerella* 1951f: p. 79, pl. 1, fig. 16.

Hindsiclava Hertlein & Strong 1955b: p. 227. Type-species by original designation: *Pleurotoma militaris* Hinds in Reeve.
hodgei, Pecten (Chlamys) 1925a: p. 42, pl. 4, figs. 1, 2.
holmani Grant & Hertlein, *Paleopneustes* 1938c: p. 112, pl. 25, figs. 1, 2.
howei Hanna & Hertlein, *Megasurcula* 1938d: p. 107, pl. 21, figs. 10, 12, 13.
howelli Hertlein & Strong, *Fusiturricula* 1951f: p. 72, pl. 8, fig. 8.
hubbardi, Pecten (Chlamys) portoricensis var. 1931b: p. 368; new name for *Pecten (Chlamys) portoricensis* var. *grandis* Hubbard, 1920, not *P. grandis* Sowerby,1828.
humboldti Hertlein & Strong, *Cyclostremiscus* 1951f: p. 110, pl. 10, fig. 1.
imperialis Hertlein & Jordan, *Rapana* 1927a: p. 631, pl. 20, fig. 1.
incantata Hertlein & Strong, *Odostomia (Miralda)* 1939b: p. 374, pl. 32, fig. 19.
inezensis Hertlein & Strong, *Taras (Taras)* 1947a: p. 130, pl. 1, figs. 1, 4.
ingrami Hertlein & Strong, *Alvania?* 1951f: p. 108, pl. 7, fig. 6.
israelskyi Jordan & Hertlein, *Astrodapsis* 1926a: p. 424, pl. 27, figs. 4, 6.
israelskyi Grant & Hertlein, *Lenita* 1938c: p. 49, pl. 8, figs. 6, 7, 9.
israelskyi Strong & Hertlein, *Turbonilla (Careliopsis)* 1939d: p. 204, pl. 19, fig. 13.
isthmica Strong & Hertlein, *Odostomia (Evalea?)* 1939d: p. 208, pl. 18, fig. 13 (not pl. 19, fig. 12, as stated).
jenkinsi Hertlein & Grant, *Discinisca* 1944a: p. 30, pl. 16, figs. 5, 6.
jordani, Buccinum 1925a: p. 41, pl. 3, fig. 3.
jordani Hertlein & Grant, *Terebratalia* 1944a, p. 125, pl. 12, figs. 1, 3, 4, 6, 7.
kanakoffi, Kelletia 1970a: p. 1, figs. 1-3.
keepi Strong & Hertlein, *Trophon* 1937d: p. 170, pl. 35, fig. 8.
kelseyi Hertlein & Strong, *Lithophaga plumula* 1946a: p. 75, pl. 1, figs. 8, 9.
kernensis, Pecten (Patinopecten) 1925a: p. 40, pl. 4, fig. 3.
kewi Jordan & Hertlein, *Astrodapsis* 1926a: p. 425, pl. 27, figs. 2, 3.
kewi Grant & Hertlein, *Brissus* 1938c: p. 128, pl. 12, figs. 1, 2.
kleinpelli Grant & Hertlein, *Echinarachnius gabbii* 1938c: p. 60; new name for *Scutella gabbi* var. *tenuis* Kew. 1915, not *Echinarachnius tenuis* Yoshiwara, 1898.
kochi Strong & Hertlein, *Iselica* 1939d: p. 227, pl. 19, fig. 11.
koticki, Haliotis 1937b: p. 94, pl. 42, figs. 1, 2.
lamberti Grant & Hertlein, *Orchoporus* 1938c: p. 52, pl. 9, figs. 3, 6.
lanieri Strong & Hertlein, *Cuspidaria* 1937d: p. 162, pl. 34, fig. 8.
liana Hertlein & Strong, *Tellina* 1945a: p. 105; new name for

Tellina "panamensis Li, 1930"[=*T. panamanensis* Li, 1930], not *T. panamensis* Philippi, 1848.

lillisi, Pecten (Pseudamusium) 1934a: p. 5, pl. 1, fig. 1; pl. 2, figs. 2, 3.

limbaughi Hertlein & Allison, *Odostomia (Chrysallida)* 1968f: p. 5, fig. 4.

liriope Hertlein & Strong, *Atys (Aliculastrum)* 1951f: p. 71, pl. 8, fig. 2.

loeli Hertlein & Grant, *Discinisca* 1944a: p. 35, pl. 2, fig. 19; text fig. 4.

loeli, Ostrea 1928b: p. 144, pl. 22, figs. 2, 3.

lohri Strong & Hertlein, *Micranellum* 1939d: p. 225, pl. 20, figs. 12, 13.

lohri, Pecten (Patinopecten) 1928a: p. 93; new name for *Pecten (Patinopecten) oweni* Arnold, 1906, not *Pecten oweni* De Gregorio, 1884.

lowei Hertlein & Grant, *Argyrotheca* 1944a: p. 95, text fig. 23.

lowei, Pecten (Chlamys) 1935b: p. 308, pl. 19, figs. 1, 2, 7, 8.

lowei Strong & Hertlein, *Volvulella* 1937d: p. 164, pl. 35, fig. 2.

lucasana Strong & Hertlein, *Nuculana* 1937d: p. 160, pl. 34, figs. 9, 12, 13.

lucasana Hertlein & Strong, *Petricola (Petricola)* 1948b: p. 194, pl. 2, figs. 4, 9.

lucasensis Strong & Hertlein, *Colubraria* 1937d: p. 173, pl. 35, fig. 17.

Macrarene Hertlein & Strong 1951f: p. 110. Type-species by original designation: *Liotia (Arene) californica* Dall.

mandannaensis, Pecten 1936c. p. 58; new name for *Pecten (Variamussium) yukonense* Lees, 1934, not *P. (Entolium) yukonensis* Smith, 1927.

manzanillense Hertlein & Strong, *Epitonium (Asperiscala)* 1951f: p. 88, pl. 3, fig. 13.

marella Hertlein, Hanna & Strong, *Nuculana (Costelloleda)* 1940b: p. 399, pl. 2, figs. 12, 13.

marksi Hertlein & Strong, *Strombina* 1951f: p. 84, pl. 2, fig. 7.

marshi Strong & Hertlein, *Triphora* 1939d: p. 209, pl. 20, figs. 2, 3.

martensiana Hertlein & Strong, *Scissilabra* 1951f: p. 111, pl. 9, figs. 1, 5, 10.

masayana Hertlein & Strong, *Turbonilla (Strioturbonilla)* 1951f: p. 101, pl. 4, fig. 4.

mazatlanica Hertlein & Strong, *Arca (Anadara)* 1943b: p. 156, pl. 1, figs. 1, 4.

mccullochae Strong & Hertlein, *Cyclostrema* 1939d: p. 239, pl. 21, figs. 8, 10, 11.

mcguirei Strong & Hertlein, *Turbonilla (Strioturbonilla)* 1939d: p. 197, pl. 19, fig. 1.

meanguerensis Hertlein & Strong, *Turbonilla (Pyrgolampros)* 1951f: p. 100, pl. 4, fig. 6.

mediamericanus Hertlein & Strong, *Latirus* 1951f: p. 80, pl. 11, figs. 3, 10.
menkeni Hanna & Hertlein, *Macoma* 1938d: p. 106, pl. 21, figs. 1, 2.
mexicanus Hertlein & Strong, *Pitar (Pitarella)* 1948b: p. 171, pl. 1, figs. 3, 8.
miguelensis, Ostrea 1928b: p. 146, pl. 23, figs. 3-6.
milleri Grant & Hertlein, *Lytechinus*? 1938c: p. 24, pl. 15, figs. 1, 2.
milleriana Hertlein & Strong, *Alvania* 1951e: p. 154, pl. 51, fig. 4.
Miogryphus Hertlein & Grant 1944a: p. 95. Type-species by original designation: *Miogryphus willetti* Hertlein & Grant.
modulatus, Pecten (Lyropecten) 1925b: p. 11, pl. 3, fig. 6.
montezumai Strong & Hertlein, *Cerithiopsis* 1939d: p. 217, pl. 20, fig. 8.
mori, Lima (Acesta) 1952a: p. 379, pl. 20, figs. 12, 13.
mörickei, Pecten 1936c: p. 55; new name for *Pecten tenuicostatus* Hupé, 1854, not Mighels & Adams, 1841.
morlini Grant & Hertlein, *Schizaster* 1956b: p. 107, pl. 29, figs. 1-8.
Morunella Emerson & Hertlein 1964f: p. 361. Type-species by original designation: *Buccinum lugubre* Adams.
muir-woodsi Hertlein & Grant, *Discinisca* 1944a: p. 32; new name for *Patella laevis* J. Sowerby, 1816, not Pennant, 1777, not Gmelin, 1791.
nahuatliana Hertlein & Strong, *Turbonilla (Strioturbonilla)* 1951f: p. 101, pl. 5, fig. 14.
Neopleurodon Hertlein & Strong 1940b: p. 419. Type-species by original designation: *Pleurodon subdolus* Strong & Hertlein.
Newaagia 1952b: p. 275; new name for *Philippiella* Waagen, 1907, not von Martens & Pfeiffer, 1886.
nicaraguana Hertlein & Strong, *Turbonilla (Strioturbonilla)* 1951f: p. 102, pl. 4, fig. 7.
nicarasana Hertlein & Strong, *Turbonilla (Chemnitzia)* 1951f: p. 92, pl. 6, fig. 8.
nicholsoni Strong & Hertlein, *Circulus* 1939d: p. 241, pl. 22, figs. 2-4.
nicoyana Hertlein & Strong, *Odostomia (Menestho)* 1951f: p. 105, pl. 8, fig. 3.
nicoyana Hertlein & Strong, *Tellina (Scissula)* 1949d: p. 85, pl. 1, figs. 23-26.
nicoyana Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 96, pl. 3, fig. 4.
Nioche Hertlein & Strong 1948b: p. 186. Type-species by original designation: *Venus asperrima* Sowerby.
noetlingi, Pecten (Chlamys) prototranquebaricus var. 1936c: p. 54; new name for *Pecten (Chlamys) prototranquebaricus* var. *paucicostatus* Vredenburg, 1928, not *P. paucicostatus* Carpenter, 1864.

nomlandi, Pecten crassicardo 1931b: p. 369; new name for *Pecten crassicardo biformatus* Nomland, 1917, not *P. biformatus* Bittner, 1899.
Notochione Hertlein & Strong 1948b: p. 188. Type-species by original designation: *Venus columbiensis* Sowerby.
Notocytharella Hertlein & Strong 1955b: p. 232. Type-species by original designation: *Cytharella niobe* Dall.
notosyriacus, Pecten 1936c: p. 58; new name for *Pecten syriacus* Blanckenhorn, 1890, not *Janira syriaca* Conrad, 1852.
oaxacana Hertlein & Strong, *Cerithiopsis* 1951f: p. 107, pl. 7, fig. 4.
oaxacana Hertlein & Strong, *Turbonilla (Strioturbonilla)* 1951f: p. 101, pl. 5, fig. 9.
ochsneri Hertlein & Allison, *Colubraria* 1968f: p. 7, figs. 6-8.
ochsneri Hertlein & Strong, *Monilispira* 1949b: p. 103; new name for *Pleurotoma bicolor* Sowerby, 1834, not Risso, 1826.
ochsneri Strong & Hertlein, *Teinostoma* 1939d: p. 244, pl. 23, figs. 6, 9, 12.
octoplicoides, Pecten 1931b: p. 368; new name for *Pecten octoplicatus* Stanton, 1901, not Bittner, 1895.
oerstedianum Hertlein & Strong, *Epitonium (Nitidiscala)* 1951f: p. 89, pl. 3, fig. 10.
osborni Hertlein & Strong, *Aesopus* 1951f: p. 83, pl. 11, fig. 2.
osunai, Ostrea californica 1966a: p. 272, figs. 2-6, 8, 9.
otnirocensis Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 96, pl. 5, fig. 4.
ottomoerchi Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 99, pl. 4, fig. 5.
ozanneana Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 98, pl. 5, fig. 15.
Pacifipecten Emerson & Hertlein 1965a: p. 355 (error for *Pacipecten* Olsson).
Paleoechinoneus Grant & Hertlein 1938c: p. 105. Type-species by original designation: *Paleoechinoneus hannai* Grant & Hertlein.
palmeri Strong & Hertlein, *Triphora* 1939d: p. 209, pl. 20, fig. 1.
panamica Hertlein & Strong, *Pseudoneptunea* 1951f: p. 81, pl. 2, figs. 6, 10.
Paphonotia Hertlein & Strong 1948b: p. 192. Type-species by original designation: *Petricola elliptica* Sowerby.
paradisi Hertlein & Strong, *Epitonium (Sthenorytis)* 1951f: p. 90, pl. 3, fig. 7.
pascua, Zafra 1962b: p. 247, figs. 1-3.
paziana Hertlein & Strong, *Semele* 1949e: p. 247; new name for *Semele regularis* Dall, 1915, not E. A. Smith, 1885.
pederseni Hertlein & Strong, *Crockerella* 1951f: p. 78, pl. 1, fig. 15.
percarus, Pecten (Aequipecten) 1925b: p. 13, pl. 2, figs. 2, 5.
pernomus, Pecten (Cyclopecten) 1935b: p. 320, pl. 18, figs. 11-13; new name for *Pecten (Cyclopecten) rotundus* Dall, 1908, not *P. rotundus* von Hagenow, 1842.

perrini Hertlein & Strong, *Cerithiopsis* 1951f: p. 106, pl. 7, fig. 5.
perrini Hertlein & Grant, *Discinisca* 1944a: p. 36, pl. 2, figs. 14, 15.
Pethopecten 1936c: p. 27. Type-species by original designation: *Pecten (Chlamys) Széremensis* Pethö.
phaneus, Pecten tehuelchus var. 1931b: p. 368; new name for *Pecten tehuelchus* var. *multicostata* Bavay, 1906, not *P. multicostatus* Nilsson, 1827, nor *P. multi-costatus* Reeve, 1852.
phoeniciensis, Pecten 1936c: p. 58; new name for *Pecten irregularis* Blanckenhorn, 1934, not Sowerby, 1842, nor M'Coy, 1844.
Phyllodella Hertlein & Strong 1949d: p. 87. Type-species by monotypy: *Tellina insculpta* Hanley.
Politoleda Hertlein & Strong 1940b: p. 397. Type-species by original designation: *Nucula polita* Sowerby.
portoparkerensis Hertlein & Strong, *Turbonilla (Ptycheulimella)* 1951f: p. 93, pl. 6, fig. 10.
posuncula Hanna & Hertlein, *Natica* 1938d: p. 107, pl. 21, fig. 6.
praevalidus Jordan & Hertlein, *Pecten (Leptopecten)* 1926a: p. 435, pl. 29, figs. 2, 3.
pretiosus, Pecten (Lyropecten) 1925b: p. 12, pl. 2, fig. 6; pl. 3, fig. 4.
proclivis Hertlein & Strong, *Tellina (Merisca)* 1949d: p. 83, pl. 1, figs. 6, 7, 14; new name for *Tellina declivis* Sowerby, 1868, not Conrad, 1834.
quaylei Grant & Hertlein, *Anorthoscutum oregonense* 1938c: p. 93; new name for *Dendraster (Calaster) oregonensis gibbosus* Kew, 1920, not *Dendraster hesperis gibbosus* Kew, 1920.
quaylei Hertlein & Grant, *Terebratalia arnoldi* 1944a: p. 122, pl. 17, figs. 1, 4, 7.
reagani Hertlein & Grant, *Hemithiris* 1944a: p. 54, pl. 3, figs. 14, 17; text fig. 9.
realejoensis Hertlein & Strong, *Turbonilla (Cingulina)* 1951f: p. 92, pl. 5, fig. 2.
recurvata Hertlein & Strong, *Tellina (Moerella)* 1949d: p. 71, pl. 1, figs. 2-4, 8.
refugioensis, Pecten (Pecten) 1925b: p. 7, pl. 1, fig. 2; pl. 5, fig. 9.
rehderi Hertlein & Strong, *Anachis* 1951f: p. 83, pl. 2, fig. 14.
rema Strong, Hanna & Hertlein, *Calliostoma* 1933e: p. 121, pl. 5. figs. 3, 4.
rhizophorae Hertlein & Strong, *Odostomia (Miralda)* 1951f: p. 105, pl. 8, fig. 1.
rhizophorae Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 98, pl. 5, fig. 12.
richthofeni Strong & Hertlein, *Caecum* 1939d: p. 224, pl. 20, fig. 11.
richthofeni Hertlein & Jordan, *Chione* 1927a: p. 619, pl. 17, figs. 4, 7, 8.
ritteri Hertlein & Strong, *Anachis* 1951f: p. 82, pl. 2, fig. 11.
rixfordi, Fissurella 1928b: p. 151, pl. 23, fig. 2.

roseola Hertlein & Strong, *Cymatosyrinx* 1955b: p. 221, pl. 2, fig. 27.
rositae, Pteria 1928b: p. 150, pl. 25, fig. 3.
saavedrai Hertlein & Strong, *Pseudochama* 1946b: p. 110, pl. 1, figs. 1, 3, 8, 10.
salvadorica Hertlein & Strong, *Elaeocyma* 1951f: p. 76, pl. 11, fig. 5.
salvadorica Hertlein & Strong, *Volsella (Volsella)* 1946a: p. 73, pl. 1, figs. 7, 11.
sawanensis, Pecten intuscostatus var. 1931b: p. 367; new name for *Pecten intuscostatus* var. *multicostata* Yokoyama, 1926, not *P. multicostatus* Nilsson, 1827, nor *P. multicostatus* Reeve, 1852, nor *P. tehuelchus* var. *multicostata* Bavay, 1906.
schencki Grant & Hertlein, *Astrodapsis* 1938c; p. 76, fig. 8.
schencki Hanna & Hertlein, *Mytilus* 1938d: p. 106, pl. 21, fig. 11.
schencki Hertlein & Strong, *Nucula (Nucolopsis)* 1940b: p. 384, pl. 1, figs. 8-10.
sealei Strong & Hertlein, *Turbonilla (Pyrgiscus)* 1939d: p. 201, pl. 19, fig. 6.
silviesi, Uptonia 1925a: p. 39, pl. 3, figs. 1, 2, 5.
similaris Grant & Hertlein, *Dendraster vizcainoensis* 1938c: p. 90, pl. 27, figs. 1, 2; pl. 28; fig. 8.
sinaloa Strong & Hertlein, *Anachis* 1937d: p. 168, pl. 35, fig. 6.
sinomarinus, Pecten 1936c: p. 27; new name for *Pecten ambiguus* Bavay, 1904, not Münster in Goldfuss, 1833.
slevini Strong & Hertlein, *Epitonium (Asperoscala)* 1939d: p. 193, pl. 18, fig. 9.
sloati, Ocenebra 1958a: p. 108, pl. 21, figs. 8, 9.
sloati, Siliqua 1961b: p. 14, pl. 5, figs. 1, 2; pl. 6, figs. 4-7.
socorroensis Hertlein & Strong, *Latirus* 1951d: p. 76, pl. 26, fig. 8.
solitarius Hertlein & Allison, *Cyclostremiscus* 1968f: p. 2, fig. 1.
soniliana Hertlein & Strong, *Turbonilla (Pyrgolampros)* 1951f: p. 100, pl. 4, fig. 2.
sorenseni Hertlein & Strong, *Trophon (Acanthotrophon)* 1951f: p. 86, pl. 2, fig. 1.
spectri Hertlein & Strong, *Macoma (Psammacoma) panamensis* 1949d: p. 91, pl. 1, figs. 9, 10, 16.
spinulosoides, Pecten tehuelchus var. 1931b: p. 368; new name for *Pecten tehuelchus* var. *spinulosa* Bavay, 1906, not *Pecten spinulosus* Goldfuss, 1834-1840.
sphoni, Lima (Plicacesta) 1963b: p. 3, figs. 1-3.
starri Hertlein & Jordan, *Crassispira* 1927a: p. 626, pl. 21, fig. 7.
stephensae Strong & Hertlein, *Cylichna* 1939d: p. 190, pl. 18, figs. 2, 5.
stevensi Grant & Hertlein, *Eupatagus* 1938c: p. 134, fig. 12.
stonei Hertlein & Strong, *"Philbertia"* 1939b: p. 375, pl. 32, fig. 8.
stonei Strong & Hertlein, *Turbonilla (Pyrgiscus)* 1939d: p. 199, pl. 19, fig. 5.

strohbeeni Hertlein & Strong, *Cymatosyrinx* 1951f: p. 77, pl. 1, fig. 14.

Strombinoturris Hertlein & Strong 1951f: p. 84. Type-species by original designation: *Strombinoturris crockeri* Hertlein & Strong.

strongiana, Acmaea 1958a: p. 109, pl. 21, figs. 1, 2.

subdolus, Pecten (Plagioctenium) 1925b: p. 20, pl. 5, figs. 2, 4, 7.

subdolus Strong & Hertlein, *Pleurodon* 1937d: p. 162, pl. 35, figs. 14, 18, 19.

subdotella Hertlein & Strong, *Odostomia (Telloda)* 1951f: p. 104, pl. 8, fig. 5.

sulacana Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 95, pl. 6, fig. 12.

suteri, Pecten (Chlamys) 1933d: p. 63; new name for *Pecten radiatus* Hutton, 1873, not *Ostrea radiata* Gmelin, 1791, nor *P. radiatus* Bosc, 1801.

swansoni Hertlein & Strong, *Pterynotus (Pteropurpura)* 1951f: p. 85, pl. 2, figs. 8, 12.

swartsi Hertlein & Jordan, *Glycymeris* 1927a: p. 620, pl. 17, figs. 1, 2.

swetti Strong & Hertlein, *Odostomia (Chrysallida)* 1939d: p. 206, pl. 18, fig. 11.

Swiftopecten 1935b: p. 319. Type-species by original designation: *Pecten swiftii* Bernardi.

tabogaensis Strong & Hertlein, *Cylichna (Cylichnella)* 1939d: p. 191, pl. 18, fig. 4.

taigai Hertlein & Strong, *Circulus* 1951f: p. 111, pl. 10, figs. 6, 8, 9.

tangolaensis Hertlein & Strong, *Crassispira* 1951f: p. 75, pl. 1, fig. 13.

teevani Hertlein & Strong, *Anachis* 1951f: p. 83, pl. 2, fig. 5.

teevani Hertlein & Strong, *Periploma* 1946b: p. 95, pl. 1, figs. 2, 6.

teglandi Hanna & Hertlein, *Natica* 1938d: p. 108; new name for *Natica dalli* Tegland, 1933, not Cossmann, 1925.

tehuantepecana Hertlein & Strong, *Odostomia (Evalina)* 1951f: p. 105, pl. 8, fig. 7.

tehuantepecana Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 99, pl. 5, fig. 7.

Tellinidella Hertlein & Strong 1949d: p. 79. Type-species by original designation: *Tellinides purpureus* Broderip & Sowerby.

Telloda Hertlein & Strong 1951f: p. 104. Type-species by original designation: *Odostomia (Scalenostoma) dotella* Dall & Bartsch.

templetonis Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 95, pl. 6, fig. 11.

terminalis Grant & Hertlein, *Echinocyamus* 1938c: p. 48, figs. 5, 6a, 6b.

texta Hertlein & Strong, *Atrina* 1943b: p. 166, pl. 1, figs. 9, 10.

tinajasensis Hanna & Hertlein, *Spiroglyphus* 1941c: p. 170, pl. 62, figs. 5, 12.

togatum Hertlein & Strong, *Epitonium (Cirsotrema)* 1951f: p. 89, pl. 3, figs. 1, 5.
tolmani Hertlein & Grant, *Eogryphus* 1944a: p. 89, pl. 5, figs. 1-3, 7; pl. 18, figs. 1, 9-11; text fig. 22.
toulai Hertlein & Jordan, *Sanguinolaria* 1927a: p. 625, pl. 20, fig. 2.
tritschi, Turritella 1928b: p. 156, pl. 24, figs. 2-5, 7, 8.
tropicalis Hertlein & Strong, *Ensis* 1955b: p. 203, pl. 3, figs. 34, 35.
trosti Strong & Hertlein, *Amphithalamus* 1939d: p. 228, pl. 21, fig. 2.
trosti Strong & Hertlein, *Poromya* 1937d: p. 163, pl. 34, figs. 3-6.
turveri Hertlein & Strong, *Acmaea* 1951e: p. 152, pl. 51, figs. 1-3.
turveri Hertlein & Strong, *Kylix* 1951f: p. 76, pl. 1, fig. 1.
ulloana Hertlein & Strong, *Cyclinella kröyeri* 1948b: p. 179, pl. 2, figs. 5-7.
ulloana, Tellina 1968a: p. 80.
ulyssi Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 96, pl. 5, fig. 10.
undatoides Hertlein & Strong, *Lucina* 1945: p. 105; new name for *Lucina undata* Carpenter, 1865, not Lamarck, 1819.
utuana Hertlein & Strong, *Turbonilla (Pyrgisculus)* 1951f: p. 93, pl. 5, figs. 6, 8.
velero, Pecten (Leptopecten) 1935b: p. 316, pl. 19, figs. 13, 14.
veleronis Hertlein & Strong, *Alvania* 1939b: p. 373, pl. 32, fig. 18.
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ynezensis Hertlein & Grant, *Eogryphus tolmani* 1944a: p. 90, pl. 18, figs. 5, 12, 13, 18.
yolettae Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 94, pl. 6, fig. 13.
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zacae Hertlein & Strong, *Teinostoma* 1951f: p. 112, pl. 10, figs. 11-13.
zacae Hertlein & Strong, *Tellina (Tellinella)* 1949d: p. 65, pl. 1, figs. 12, 13, 17.
zacae Hertlein & Strong, *Turbonilla (Pyrgiscus)* 1951f: p. 95, pl. 3, fig. 3.
Zacatrophon Hertlein & Strong 1951f: p. 86. Type-species by original designation: *Trophon (Boreotrophon) beebei* Hertlein & Strong.

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NEW PLIOCENE *CHLAMYS (SWIFTOPECTEN)* AND *BERINGIUS* FROM THE ALASKA PENINSULA

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The two new species here described were collected from the upper ledge of the beach cliff at Cape Tachilni, near the western end of the Alaska Peninsula, presumably from the Tachilni Formation (Pliocene) of Waldron (1961, p. 686). The collection was made by a field party of the Standard Oil Co. of California in 1967 and subsequently donated to the U. S. Geological Survey at Menlo Park, California, where it bears USGS Cenozoic loc. no. M4044. The types and one other figured specimen are deposited in the U.S. National Museum.

Neither species has been found previously in Alaska although beds of the same age probably are present elsewhere in the Alaska Peninsula and around the northern border of the Gulf of Alaska.

Genus *Chlamys* Röding 1798
Subgenus *Swiftopecten* Hertlein 1935

Assignment of the present new species to *Swiftopecten* can hardly be made without some discussion of the delimitation of the subgenus. The type species, the Recent *Chlamys (Swiftopecten) swifti* (Bernardi), is, perhaps, the most extreme member of the subgenus as commonly construed. Similar forms are known at least as far back as the middle Miocene (Otsutsumi Formation) of northern Honshu, Japan (Masuda, 1959, pl. 9, fig. 1), as well as in several intermediate Pliocene and Pleistocene formations. Another group of species, and the one to which the present new species belongs, is well represented in the Pliocene of California and the Miocene and Pliocene of Japan. The California species, which include *Pecten wattsi* and *Pecten nutteri* of Arnold (1906), are referred to *Swiftopecten* by recent American authors. The Japan-

ese counterparts comprise *Pecten cosibensis* Yokoyama and its various subspecies (see Masuda, 1959-b). A few Japanese authors have referred one or the other of these forms to *Swiftopecten,* but they are not now so regarded by Masuda (1962, p. 149), the foremost of the modern Japanese students of pectinids. Grant and Gale (1931), on the other hand, placed *P. cosibensis* Yokoyama and *P. heteroglypta* Yokoyama, the latter now generally regarded as a subspecies of *P. cosibensis,* in the synonymy of two California species.

The Otsutsumi Formation contains another species, *Pecten (Swiftopecten?) otutumiensis* Nomura and Hatai, that probably is referable to *Swiftopecten.* One Oligocene species, *Chlamys kitamurai* Kotaka, that could likewise belong to the subgenus.

Masuda (1960, p. 380) concluded that typical *Swiftopecten* was descended from *Nanaochlamys* Hatai and Masuda and could not, therefore, be construed as a subgenus of *Chlamys.* The *P. cosibensis* group he referred to *Chlamys.* In the writer's opinion, neither of these groups is related to *Nanaochlamys* but represent two distinct sections of *Chlamys (Swiftopecten).* A possible third group, which is more closely related to *C.* (*S.*) *swifti* than to *C.* (*S.*) *cosibensis,* is represented by *C. (S.) donmilleri* MacNeil from the middle Miocene of Alaska and *C. (S.) parmeleei* (Dall) from the Pliocene of California.

There is no rule or policy that restricts a generic name to a single phylogenetic lineage. Some multilinear diversification must be admitted in every genus and the limits of such diversification must be entirely arbitrary. The assignment of the present species to *Swiftopecten* is made with the conviction, therefore, that it does not belong to the group represented by the type species, but to a parallel group of common ancestry and of sufficient morphological similarity to be included in *Swiftopecten.*

Chlamys (*Swiftopecten*) *leohertleini* MacNeil, n. sp.

figs. 1-3

Description: Shell of medium size, moderately inflated, slightly higher than long. Apical angle moderately broad and nearly symmetrical, possibly broader in young juveniles. Ears moderately large; anterior ear broad, byssal sinus narrow and of moderate depth; posterior ear with a nearly vertical posterior margin. Dorsal margins subequal in length, posterior margin straight, anterior

margin very weakly concave. Juvenile sculpture discordant and irregular, right valve with about 8 primary fascicles, each consisting of from 3 to 7 secondary riblets of unequal size and spacing, left valve with primary lirations corresponding to interfascicular areas of right valve and broad irregularly lirate interspaces corresponding to fascicles of right valve. Adult sculpture consisting on the right valve of irregular and poorly defined plications resulting from the fusion of the secondary riblets at the first growth varix; left valve with more sharply rounded and weakly nodose plications, some of the secondary lirations of the juvenile stage developing unevenly as secondary and tertiary plications. Growth varices stronger and more widely spaced on young stages, about 3 on medium sized individuals, about 6 on large specimens. Ears sculptured with moderately strong ribs and interspaces of about equal width. Byssal fasciole with growth lines only.

Discussion: The only fossil reported previously from Alaska that bears any resemblance to this species is a fragment (MacNeil, 1967, pl. 8, fig. 9) from the middle part of the section (supposedly Pliocene) of Tugidak Island and referred, with other fragments, to *Chlamys* ("*Chlamys*") aff. *C.* ("*C.*") *trinitiensis* MacNeil.

Chlamys (Swiftopecten) leohertleini has a wider apical angle and more irregular sculpture than either *C.* (*S.*) *cosibensis* (Yokoyama) or the most closely related California species, *C.* (*S.*) *nutteri* (Arnold). Furthermore, there is more discordance between the juvenile and adult sculpture of *C. (S.) leohertleini* than in any other known species of the subgenus.

Dimensions: The holotype (U.S. Nat. Mus. Cat. no. 646461) measures: height, 69.5 mm., length, 64.5 mm. The smaller figured left valve (U.S. Nat. Mus. Cat. no. 646462) measures: height, 61 mm., length, 53.5 mm. The largest specimen collected, a right valve with 6 growth varices, measures: height, 94 mm., length, 89 mm.

Genus *Beringius* Dall 1879

The genus *Beringius*, as presently construed, would seem to defy generic description. All species assigned to the genus have a prominent protoconch of 4 to 5 whorls which ranges from narrowly conical to nearly straight. The ribs range from very strong and crudely T-shaped to nearly obsolete. Some species have well defined curved axial ribs whereas other species have no suggestion of axial ribs. The suture ranges from weakly appressed to deeply

sunken. Some species have well defined shoulders whereas other species are bulbous and rounded. The strong, swollen siphonal fasciole that characterizes the typical section of the genus is weak or absent on some other species assigned to the genus. Nevertheless, one gets the distinct impression that the species now included in *Beringius* are closely related and that if the genus is ever subdivided the new taxon or taxa will remain as subgenera of *Beringius*. As with numerous other cold water gastropod genera, *Beringius* appears to be undergoing major evolutionary change and diversification at the present time.

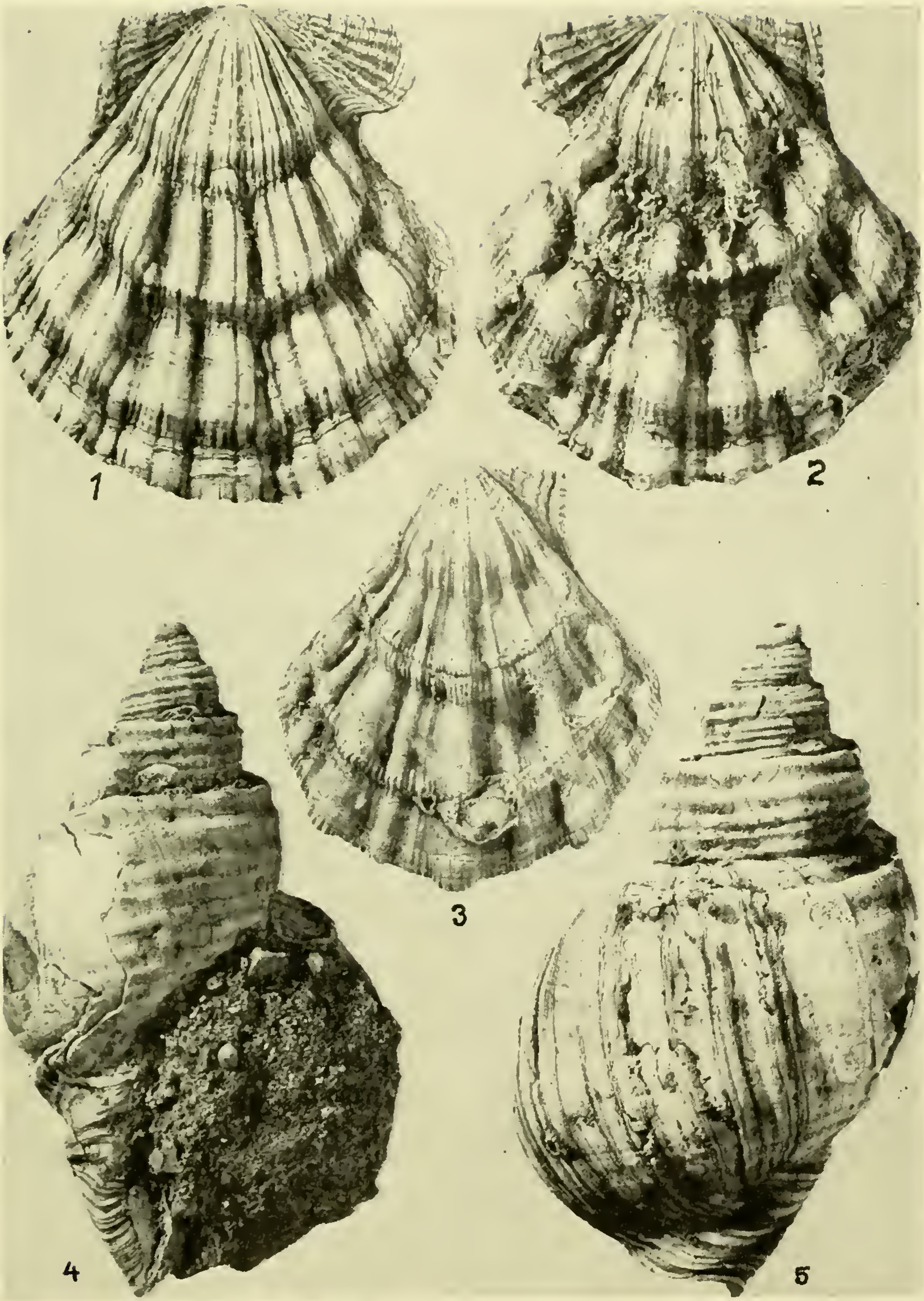
Beringius hertleini MacNeil, n. sp.
figs. 4–5

Description: Shell of medium size for the genus; spire moderately high; protoconch unknown; body whorl moderately rounded, early whorls less rounded; sutures weakly incised; shoulders moderately narrow, subtabulate and sloping, subtended by an upturned blunt collar; aperture subrounded, more swollen anteriorly; inner lip curved with a moderately thick callus; siphonal notch moderately indented, siphonal fasciole moderately inflated and curved. Sculpture consisting of crude spiral ribs which are stronger on the spire whorls, about 4 to 5 on the early whorls and about 10 to 12 on the body whorl, those on the body whorl tending to become nearly obsolete in the most advanced stage. Growth lines irregular in both size and spacing.

Discussion: Although clearly distinct, *B. hertleini* is more closely related to the type species, *B. crebricostatus* (Dall) than to any other described species of the genus. Both species have strong to moderately strong spiral ribs and no axial ribs, and on both species the uppermost spiral sets off a shoulder concavity. All other known species of the genus have rounded shoulders and axial ribs of varying strength (See Smith, 1959).

The spiral ribs of *B. hertleini* are weaker than those of *B. crebricostatus,* much weaker on the body whorl, and they have no tendency to be T-shaped. The spire is lower on *B. hertleini* and the sutures are less sunken. The whorls are more inflated and the siphonal fasciole is more prominent.

A possible undescribed early relative of this species occurs in the lower part of the Yakataga Formation (horizon probably middle Miocene) along the northern Gulf of Alaska. The Yaka-



Figs. 1-2. *Chlamys (Swiftopecten) leohertleini* MacNeil, n. sp. Right and left valves of holotype. Fig. 3. Same, left valve. Figs. 4-5. *Beringius hertleini* MacNeil, n. sp. Apertural and rear views of holotype.

taga species is more slender but the gradual weakening of the spiral ribs with age is similar. The Yakataga species has a straight columella, however, and there is no suggestion of a swollen siphonal fasciole. The aperture of the Yakataga species is more like that of *Neptunea*.

Dimensions: The holotype (U.S. Nat. Mus. Cat. no. 646463) measures: height 99 mm., diameter 60 mm.

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PELECYPODS, SUCCESSFUL INVADERS OF THE INFAUNA

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Although the fact that the sudden appearance of many different marine invertebrate groups in the Early Cambrian is well known, still these early faunas were relatively impoverished. It was not until the beginning of Middle Ordovician time that the marine invertebrate faunas had a diversity that would compare favorably with living marine faunas. The gradual increase in diversity of the marine invertebrate faunas occurred throughout the Middle and Late Cambrian and into the Early Ordovician. The fossil record clearly indicates that new phyla and classes of invertebrates became adapted to all of the major marine realms, including burrowers into the substrate (infaunal), sessile or vagrant bottom dwellers (epifaunal), swimmers (nektonic), and floaters (planktonic). None of these major realms of the seas was completely filled by invertebrates until the Middle Ordovician. Throughout the rest of the Paleozoic, the marine invertebrate communities became relatively stable with extinction and replacement occurring mostly at the generic and familial levels.

The remainder of this discussion on Early Paleozoic marine faunas will be restricted mainly to animals that burrow into the sea bottom for either protection or food. Traces of both feeding and dwelling burrows have been noticed in Late Precambrian and Cambrian clastic sediments. The burrows were made by soft-bodied animals that were not fossilized. Among the animals having a good fossil record, few Cambrian groups were able to burrow. A few trilobites may have been capable of some shallow burrowing, but most trilobites apparently crawled along the bottom. Among the brachiopods, only some of the lingulaceans were burrowers, and the vast majority of brachiopods were epifaunal animals. The list of major groups of Cambrian invertebrates, taken mainly from Harland, et al. (1967), gives clear indication that no other invertebrates were burrowers during Cambrian time. With the advent of the pelecypods, we have for the first time a large group of shelled invertebrates, the majority of whose representatives were adapted for a life of burrowing in the soft sediments of the sea bottom. Although questionably appearing

as early as the Middle Cambrian, pelecypods did not become reasonably common and diverse until about the early part of the Middle Ordovician. By that time the protobranchs were well established and were feeding on organic material in the deposits of the ocean bottom. From the shape of the shells, one can deduce that most of the rest of the basic stocks of Ordovician pelecypods were also burrowers, but mytiloids, which appear to have been byssally attached epifaunal forms, are abundant and diverse in Middle and Late Ordovician faunas. Burrowing species in the Ordovician were about 70 per cent of the total pelecypod fauna, just as they are today (Nicol, 1968). Stanley (1968) has emphasized the fact that many new groups of burrowing and boring pelecypods appeared throughout the Mesozoic and Cenozoic, and these were more efficient infaunal animals as a consequence of mantle fusion and siphon formation. However, the epifaunal pelecypods also increased greatly in diversity throughout the Mesozoic and Cenozoic.

At least one other group of animals with well developed skeletons successfully invaded the infauna, the irregular echinoids during the Jurassic, but the possible competition for space within the substrate by these animals did not seem to affect the increasing diversity of infaunal pelecypods from Jurassic onward.

Bretsky (1969) has noted that the most stable Paleozoic marine community was the nearshore or onshore one dominated mainly by infaunal linguloid brachiopods and the deposit-feeding protobranch pelecypods. This onshore environment would have more fluctuations in temperature and salinity than regions of deeper water farther from shore, and one would expect that these onshore communities would have more rapid changes in evolution or community composition because of the unstable environmental conditions. That this is not the case may be due in part to the fact that the infaunal animals were somewhat protected from rapid changes of temperature and salinity by living in their burrows or within the substrate, and the further fact that competition from other animals was negligible.

In conclusion, the infaunal realm was still little occupied by marine invertebrates in the Cambrian, and the pelecypods with their digging foot were well adapted to invade this area during the Ordovician and have continued to be successful infaunal animals to the present.

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NEWS

The subscription price to The Nautilus, beginning with the July, 1971 issue (vol. 85, no 1) will rise slightly to $5.00 per year ($5.75 foreign). $1.50 per copy.

George F. Kline, well-known collector and benefactor of malacology, died in Honolulu, Hawaii, on June 9, 1970. He was born in Elizabeth, New Jersey, on October 26, 1907. George and his wife, Mary Clapp Kline, began collecting in the Bahamas in 1948, and later participated in numerous scientific expeditions sponsored by the Academy of Natural Sciences of Philadelphia. He was a Director of the Natural Science Foundation and a member of the business board of Indo-Pacific Mollusca. He contributed several articles to The Nautilus, and helped develop new ideas in the collecting, photographing and curating of mollusks.

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CADULUS (GADILA) PERPUSILLUS (SOWERBY, 1832), AN EARLIER NAME FOR *C. (G.) PANAMENSIS* SHARP AND PILSBRY, 1898

By William K. Emerson
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Dentalium perpusillum G. B. Sowerby, I (1832, p. 29) was described from Puerto Salango, "West Columbia" [Panama], in 10 fathoms. Sowerby did not provide an illustration, but he noted in the brief description that his taxon was related to *Dentalium gadus* [= *Cadulus (Gadila) gadus* (Montagu, 1803)]. The status of this Panamic species of *Cadulus* became confused when G. B. Sowerby, II (1860, p. 104) referred *D. perpusillus* to the annelid genus *Ditrupa* in his monograph of the Scaphopoda in the *Thesaurus Conchyliorum.* Considering the time, this systematic assignment was not unusual. As the result of the inadequate original description and the lack of an illustration, the identity of Sowerby's *Cadulus perpusillus* has remained in doubt to the present time.

In a review of the living and extinct scaphopods, Pilsbry and Sharp (1898, p. 190) surmised that Sowerby's taxon might be conspecific with the eastern Pacific taxon they described as *Cadulus (Gadila) panamensis* Sharp and Pilsbry (1898, p. 191, pl. 36, figs. 23-25). They preferred to propose a new species in the absence of the type material of *C. perpusillus.* Dall (1909, p. 249) followed this concept at first. He referred specimens from off Baja California, Mexico to Guayaquil, Ecuador, to *C. perpusillus,* citing figures of Pilsbry and Sharp (1898, pl. 36, figs. 23, 24) representing *C. panamensis.* In a later paper, Dall (1921, p. 58) extended the range of *C. perpusillus* north to Monterey, California. This taxon, however, apparently is restricted to the Panamic faunal province and it is not known to range north of Cedros Island along the west coast of Baja California. It does occur throughout the Gulf of California, and it is reported by

[1] Submitted in honor of Leo George Hertlein; see vol. 84, no. 2, Oct. 1970.

Jordan (1936, pp. 112, 149) as a Pleistocene fossil from Magdalena Bay, Baja California. In extending the range into the Californian and Oregonian faunal provinces, Dall (1921) expanded his concept of Sowerby's species. Several subsequent students accepted this revised interpretation, making it difficult to ascertain what species were included in the literature under the name of *C. perpusillus*. In recent years, most workers have considered Sowerby's taxon to be a *species inquirendae,* and the name *C. panamensis* has been used.

Through the courtesy of the late William J. Rees, I was able to obtain on loan the type lot of *C. perpusillus* from the British Museum (Natural History). It consists of five specimens mounted on a wooden block with a label reading "*D. perpusillum* Sow., Salango, W. Columbia, sandy mud, 10 fms., H.[ugh] C.[uming]." These data correspond to those given in the original description. The largest specimen is 7.5 mm. in length; the smallest is 6 mm. in length. The best preserved specimen, which measures 7.2 mm. in length, with an oral aperture of 0.75 mm. in diameter and an apical orifice of 0.33 mm. in diameter, is designated here the lectotype. This specimen possesses well-defined annular sculpture (fig. 3A-D). In the four paralectotypes, the encircling wrinkles are less developed but they are evident under magnification.

The type lot of *Cadulus (Gadila) panamensis* Sharp and Pilsbry, 1898, is deposited in the U.S. National Museum. It comprises eight specimens dredged in the Bay of Panama in 51 fathoms (U.S.F.C. Station 2805). A lectotype is selected, U.S.N.M. no. 122795, and illustrated herein (figure 2).

A comparison of the typological specimens of *C. perpusillus* (Sowerby, 1832) with those of *C. panamensis* Sharp and Pilsbry, 1898, indicates that these nominal species are conspecific. Thus, *Cadulus (Gadila) perpusillus* (Sowerby) is known to range from Cedros Island, Baja California, Mexico, to Consag Rock, near the head of the Gulf of California, and south to Panama Bay, Panama, and the Galápagos Islands; ? Ecuador (Dall, 1909).

The shell characters of this species are very distinctive. The conspicuous constriction near the oral aperture and the encircling wrinkles serve admirably as distinguishing characters. The degree of development and number of wrinkles varies considerably among individuals (figs. 3D, 4D). The annular sculpture is commonly retained only on well-preserved specimens; some speci-

mens lack surface sculpture. The size and outline of the shell also is quite variable. A large, stout form was named *C. panamensis* var. *major* by Pilsbry and Sharp (1898, p. 192, pl. 36, figs. 28 [lectotype here selected and illustrated, fig. 1] 29, 30 [paralectotypes]). Another infrasubspecific form, which is long and slender, approaches *C. (Gadila) leptodoma* Pilsbry and Olsson, 1941 (p. 49, pl. 10, fig. 11), a taxon described from the Pliocene of Ecuador. A similar, Recent specimen from the Bay of Panama is illustrated, figures 4A-D.

The present species is closely related to the western Atlantic *C. acus* Dall (1889, p. 423, pl. 27, fig. 11), but it is larger, more curved, and has a greater apertural contraction. *Cadulus dentalinus* (Guppy, 1873, pp. 87, 88, pl. 1, fig. 11), from the Miocene of Jamaica, has a very similar shell, but that of *C. perpusillus* is slightly stouter. The present species resembles other nominal species described from late Tertiary deposits in the Caribbean region.

These small, needle-shaped species, with distinctive annular sculpture are known to occur from the Miocene to Recent time in mid-latitudes of the New World, and at least one species is recorded from the tropical western Pacific Ocean. This group was afforded nomenclatural recognition by Woodring (1925, p. 206), who proposed the taxon *Gadilopsis* as a section of the subgenus *Gadila* Gray, 1847. As I have pointed out elsewhere (Emerson, 1962, p. 478), circular sculpture is not developed in all constituents of the extinct and living populations of the American species comprising this complex. Therefore, I have retained this group in *Gadila* (type species by original designation: *Dentalium gadus* Montagu, 1803). Should anatomical studies demonstrate that this is a valid species group, *Gadilopsis* (type species by original designation: *Ditrupa dentalina* Guppy, 1873) would be applicable.

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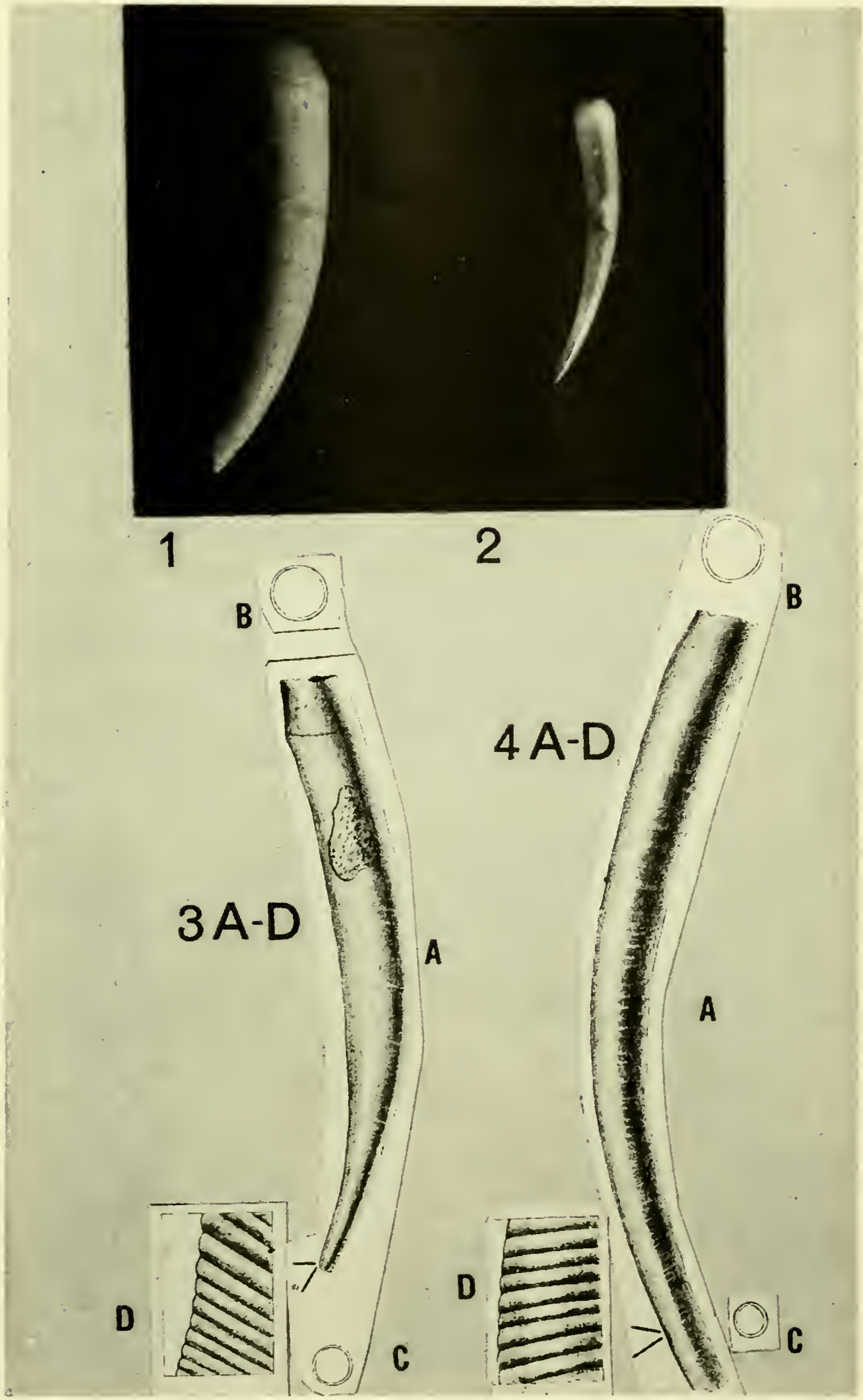
Cadulus (Gadila) perpusillus (Sowerby)

Figure 1. Lectotype of *Cadulus (Gadila) perpusillus* var. *major* Pilsbry and Sharp, 1898, U.S.N.M. No. 96570, off Baja California, Mexico, in 66 fathoms (U.S.F.C. Sta. 2830) ; x 5.

Figure 2. Lectotype of *C. (G.) panamensis* Sharp and Pilsbry, 1898, U.S.N.M. No. 122795, Bay of Panama, in 51 fathoms (U.S.F.C. Sta. 2805); x 5.

Figure 3A-D. Lectotype of *Dentalium perpusillum* Sowerby, 1832, Puerto Salango, Panama, in 10 fathoms, British Museum (Natural History); A, B x 10; C x 30; D x 38. Fig. D, detail of sculpture of a portion of the surface near anal aperture.

Figure 4A-D. Example of attenuated form of *Cadulus (Gadila) perpusillus* (Sowerby) , Toboga Island, Panama, in 2 to 5 fathoms (A. Hancock Foundation bottom sample No. 346); A, B, C, x 10; D x 38. Fig. D, detail of surface sculpture.



Explanation of figures (opposite page)

NEW TYPHID SPECIES FROM THE SOUTH CHINA SEA

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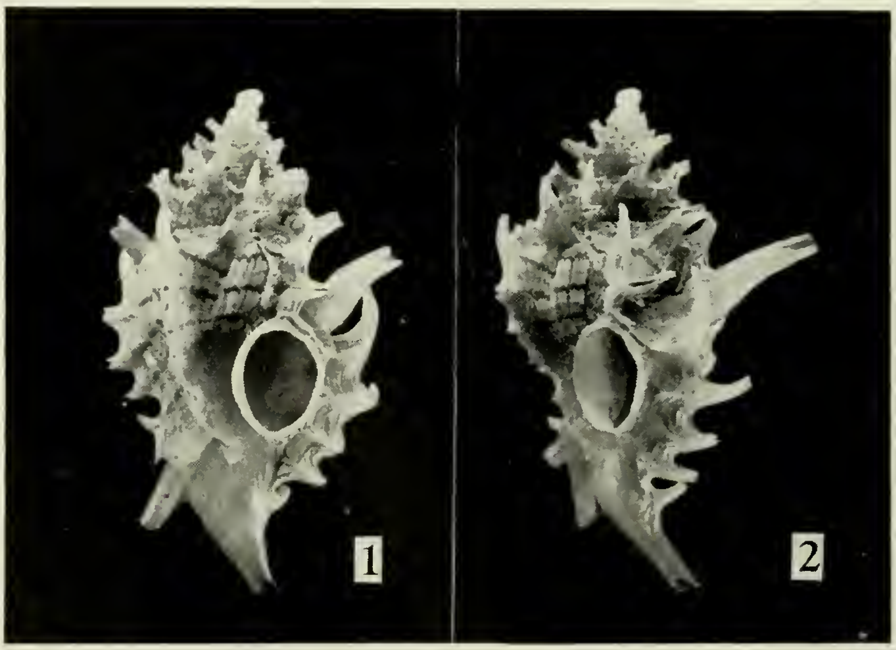
The writers have received two typhid species collected by coral fishing boats from the South China Sea through Dr. Kin'ichi Sakurai and Mr. Seiji Suzuki, of Maruma Shell Co. One is *Typhis (Monstrotyphis) tosaensis* Azuma and another is a new species described herewith. The writers express their sincere thanks to the gentlemen mentioned above for their kind cooperation.

Typhis ramosus, *new species* (Figures 1, 2)

Description—Shell rather large for the typhid group, biconic in shape, stout, pale-brown in color, ornamented with reddish brown, transverse lines of 2 on the teleoconch whorls and of 5 on the body whorl, but with a chalky bloom on the surface in the fully grown specimens. Spire conically elevated. Protoconch of 2 whorls bearing a papillary tip which is smooth and polished, translucently white, roundly convex. Teleoconch of 4.5 whorls, foliated with varices which are 4 per whorl, arranged and continuing up to the earlier whorls spirally, and with 2 spines on the teleoconch whorls and 5 on the body whorl. Spines bent back and sharply pointed at the tip, except the shoulder spine which



Figs. 1, 2. *Typhis ramosus* Habe and Kosuge, *new species*. Holotype, 16.3 mm. in height.

is bent upward. Posterior siphonal tubes arising about midway between the varices, long and slender to the tip, slightly curved basally. The last siphonal tube near the aperture is apparently the largest and longest of them. Intervarical area has weak growth lines; 2 brown lines are on the teleoconch whorls and 5 on the body whorl. Aperture roundly ovate with a continuous peristome, and produced forward and apart from the penultimate wall. Varix at the outer margin rather broad and stout, armed with spines. Anterior siphonal tube broad at the base and attenuating towards the distal end, and slightly curved backward; closed throughout and forming a tube. Operculum roundly ovate rather thick, reddish brown and with the nucleus near the lower end.

Height 16.3 mm. and breadth 9.0 mm. (type specimen preserved in the National Science Museum, NSMT—Mo—38872). Height 21.3 mm. and breadth 11.3 mm. (paratype specimen preserved in the National Science Museum-Mo).

Type locality—South China Sea.

Remarks—*Typhis philippensis* Watson from Port Philip, Melbourne, South Australia, is closely allied to this new species in general features, especially in having the spines on the varices. However, it has no spiral colored bands on the surface, nor the narrow and long anterior siphonal canal of *ramosus*.

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NEW ANCISTROLEPIS FROM THE BERING SEA (BUCCINIDAE)

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The genus *Ancistrolepis* was established by Dall in 1894 with *Chrysodomus eucosmius* Dall from Alaska designated the type species. Four species and two subspecies, namely *A. eucosmius* Dall, *A. e. bicinctus* Dall, *A. beringianus* Dall, *A. gemmatus* Dall, *A. g. yamazakii* Kuroda, and *A. hikitai* Kuroda, have been reported from the Northern Pacific. Recently we received a specimen from the Bering Sea which is very close to the type species in the general features. But it has a conically turrited shell with three prominent spiral cords equidistantly placed to each other and one subsutural cord just below the upper suture on the whorls, and four basal spiral cords in addition to them on the body whorl. It seems to be a new subspecies of *A. eucosmius* Dall.

We wish to express our sincere thanks to Mr. Seishiro Koyama who sent this specimen for our study.

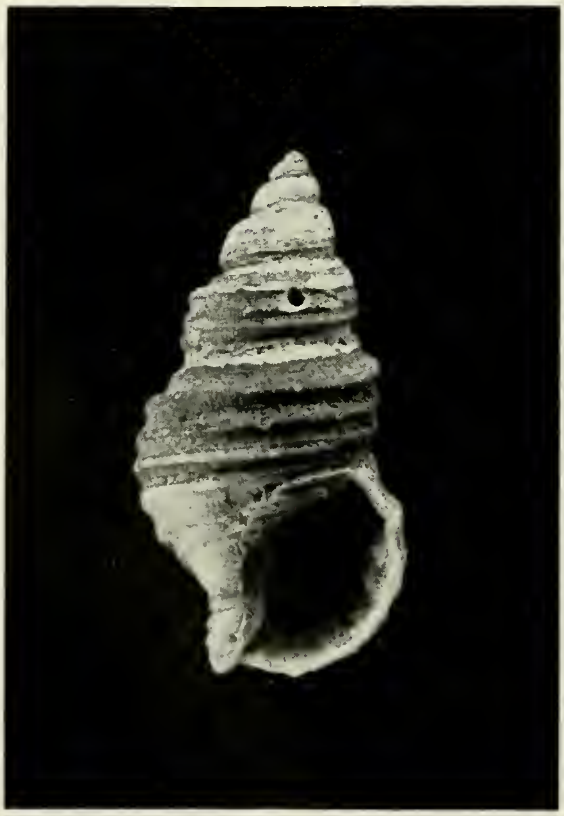

Fig. 1. *Ancistrolepis eucosmius koyamai* Habe and Ito *new subspecies*. Holotype. 37.5 mm. in height.

Ancistrolepis eucosmius, koyamai, new subspecies (Fig. 1)

Description—Shell is rather small for the genus, white, solid, conically turreted, with six whorls excluding the eroded nucleus, covered with a thick olivaceous and densely lamellated periostracum. Each whorl has four spiral cords and minute spiral threads between them. The uppermost cord just below the suture is rather weakly formed. Below a rather wide space is a prominent cord on the shoulder; the other three cords are prominently and equidistantly-placed. The body whorl is as large as three fifths of the shell height and has eight spiral cords which are also prominent (excluding the subsutural cord) and are subequidistantly arranged on the base. The aperture is ovate with a wide, short siphonal canal, white within, internally bearing shallow grooves. The outer margin is roundly curved and waved at the edge by the ends of the spiral cords; columellar pillar short and callous and somewhat twisted near the end of the distinct fasciole.

Height 37.5 mm. and breadth 19.8 mm. (figured type specimen preserved in the National Science Museum, NSMT—MO. 38541).

Type locality—Bering Sea (more exact locality unknown).

Remarks—*Ancistrolepis fujitai* Kuroda and *A. kinoshitai* Kuroda have been removed to the genus *Parancistrolepis* Azuma because they have multicuspidate marginal teeth superficially very close to those of the genus *Fusinus* in the family Fasciolariidae. *A. trochoideus* Dall and *A. t. ovoideus* Habe and Ito are allocated to the subgenus *Bathyancistrolepis* Habe and Ito the nodule of which has three cusps on the marginal tooth, with the middle one minute in size.

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ENVIRONMENTAL CONTROL OF FORM IN LAND SNAILS A CASE OF UNUSUAL PRECISION

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We are removed nearly a century from the time when land snails first played devil's advocate to Darwinism. The advocate: *Achatinella.* Mephisto: none other than the Reverend Gulick (1873). The claim: geographic variation in form proceeds from isolation alone; it is spontaneous and unrelated to climate or habitat. Nonetheless, when conchologists marvel at the wondrous diversity of *Cerion, Liguus, or Partula* and doubt that it is either adaptive or even correlated with the variation of environments, they merely repeat Gulick's claim, though it has been disproved for his own material (Welch, 1938, 1942, 1958).

To this historic argument against selection that Gulick proposed and Crampton (1916, 1925, 1932) pursued, the modern evolutionist responds by recording correlations between form and environment. To be sure, not all such correlations refute the antiselectionist thesis since many, especially in intraspecific situations, are produced directly and have no genetic basis. But even these purely phenotypic events can reinforce a selectionist interpretation because their direction may correspond to similar genetic events at higher systematic levels. Having recognized the phenotypic effect, we may be able to give an adaptive explanation for the genetic differences. In Bermudian land snails of the subgenus *P. (Poecilozonites),* for example, the correlation of shell thickness with available $CaCO_3$ is pervasive, but the effect is almost surely phenotypic in some cases (thick shells on limestone

walls, thin in a neighboring field—Gould, 1969b, p. 491, no. 7) and definitely genetic in others (development of paedomorphic, thin-shelled subspecies of *P. bermudensis* in lime-poor red soils—Gould, 1969b, pp. 478-479).

Another reason for tabulating all correlations of form and environment as potential support for selectionist views lies in the difficulty of sorting phenotypic from genetic effects—any list will almost always include some genetic events. This inability, in most cases, to identify the causes of a correlation has often been noted, usually with dismay and sometimes even with despair (Best, 1961, on trilobites; Jolicoeur, 1959, on wolves; Nichols, 1962, on heart urchins; Mitra, 1958, on brachiopods; and, for land snails, Rensch, 1932, on the albinism of xerophiles and Welch, 1958, for *Achatinella*).

A strategy for demonstrating the close relationship between environment and form in land snails might proceed in three stages. First, we must map geographic variation to see if it correlates with topography, temperature, soil type, or any other environmental factor—see, for example, Welch (1958), Rensch (1937), Baker (1924), and Gould (1969a). Secondly, we want to know how predictable and precise the environmental control upon form has been. The temporal recurrence of climatic cycles during Pleistocene ice ages often induced fluctuations in form that mirror the climatic curve precisely—see, for example, Kurten (1965) for size in mammals, Ericson (1959) for coiling directions in foraminifera, and Gould (1970) for size, umbilical width and shell thickness in land snails. Finally, a hypotheses of climatic control will be greatly strengthened if several taxa reacted in the same way to the same set of climatic events—see Reyment (1966) on Nigerian fossil ostracods.

The following case belongs to this last, and most remarkable, category of precise determination for several taxa.

Five species of helicoid land snails are found in a Pleistocene red soil at Tom Moore's Cave, Hamilton Parish, Bermuda (Locality 53 of Gould, 1969b; see Bretz, 1960 and Land, Mackenzie and Gould, 1967 on Bermudian geology; the soil belongs to the Shore Hills formation and represents a pre-Sangamonian glaciation). The species are distributed in three very different size ranges:

Table 1. Umbilical Widths for Five Species of Helicoid Land Snails at Tom Moore's Cave vs. all other Shore Hills Samples (in mm).

	Tom Moore's	Average of others	Range of others	N for others
1. Large *Poecilozonites* (at height + width = 30 mm)				
a) *P. bermudensis*	3.01	2.32	2.26-2.40	4
2. Small *Poecilozonites* (at width = 9.3 mm)				
a) *P. circumfirmatus*	1.97	1.55	one sample only	1
b) *P. reinianus vanattai*	3.85	3.34	3.14-3.45	4
c) *P. blandi heilprini*	2.80	2.53	2.34-2.70	4
3. Microgastropods (at width = 1.9 mm)				
a) *Thysanophora hypolepta*	0.81	0.74	0.72-0.76	3

1. The endemic sagdid *Thysanophora hypolepta* Shuttl. at ca. 2 mm in adult width.

2. Three species of the two smaller subgenera of the outstanding, endemic genus *Poecilozonites* all ca. 10 mm in adult width —*P. (Gastrelasmus) circumfirmatus* Rdfld., *P. (Discozonites) reinianus vanattai* (Pilsbry) and *P. (D.) blandi heilprini* Pilsbry.

3. The large *P. (Poecilozonites) bermudensis* Pfr., reaching adult widths up to 28 mm.

I noticed that umbilical widths seemed to be greater at this locality than for others from the same time period; consequently, I measured umbilici for these five species in all samples of the Shore Hills soil.

Comparisons among samples of the same species must be made at a common standard (size, whorl number, age or developmental stage, for example). Otherwise, real differences cannot be distinguished from artifacts that result from varying ontogenetic size distributions among samples. Likewise, the common practice of using ratios to "avoid" differences in size does no such thing, for allometry (Gould, 1966) is defined as size-correlated change of shape (i.e. of ratios) and strictly isometric growth is not common—and certainly impossible in snails with domed spires because height must grow faster than width to produce a dome. Helicids, cerionids and many other land snails have a recogniza-

ble adult stage that serves as an obvious standard for comparison; but both *Thysanophora* and *Poecilozonites* grow throughout life and show no change of coloration, shell thickness or coiling direction to mark the adult. I chose to make comparisons at standard sizes (1.9 mm width in *Thysanophora,* 9.3 mm for the three small *Poecilozonites* and 30 mm height + width for *P. bermudensis*). I chose each sample to represent as large an ontogenetic series as possible and computed the regression of umbilical width upon total width for each. (Although both variates are subject to error, regression of y on x is still the appropriate curve-fitting technique because we are trying to predict y at some given value of x. For each species, the standard size is chosen, to avoid the dangers of extrapolation, as the largest size well within the measured range of all samples). The values recorded on Table 1, therefore, are those predicted from the regression equations at the standard sizes for each sample.

For each of the five species, umbilical widths at standard sizes are larger in the Tom Moore's sample than in any other contemporaneous sample. I am particularly impressed by the fact that this environmental control is exerted in such a similar and precise way over such a range of species sizes.

What is the environmental significance of a wide umbilicus? In *P.* (*Poecilozonites*), there is a persistent negative correlation between shell thickness and umbilical width (Gould, 1969b). This results from two factors: a tendency for thick shells to be strongly domed and constriction of the umbilicus at the aperture by a thickened inner lip. Shell thickness, at least in *P.* (*Poecilozonites*), is an almost automatic response to the availability of $CaCO_3$ for shell construction. (The correlation of shell thickness with available lime is the best documented of correlations between form and environment in pulmonates—see, for example, Rensch, 1932; Oldham, 1929 and 1934; Boycott, 1934; Robertson, 1941; and Frank and Meyling, 1966). The lime content of Bermuda's red soils ranges from less than 2 percent to more than 50 percent (Ruhe, et al., 1961). I would infer, therefore, that the soil at Tom Moore's Cave was poorer in lime than that of any other Shore Hills sample.

As to the genetic basis of these differences in umbilical width, I can only conjecture; but the conjecture raises an interesting

possibility. For the three small *Poecilozonites* and for *Thysanophora,* the Tom Moore's shells exhibit no evident differences from their contemporaries beyond the distinction in umbilical widths (Fig. 1a). If the extent of genetic change is related to the degree of phenetic difference (which, of course, it need not be), we might want to ascribe these umbilical effects to direct environmental induction. They do, at least, conform to the usual criteria for such inferences—extremely local events involving

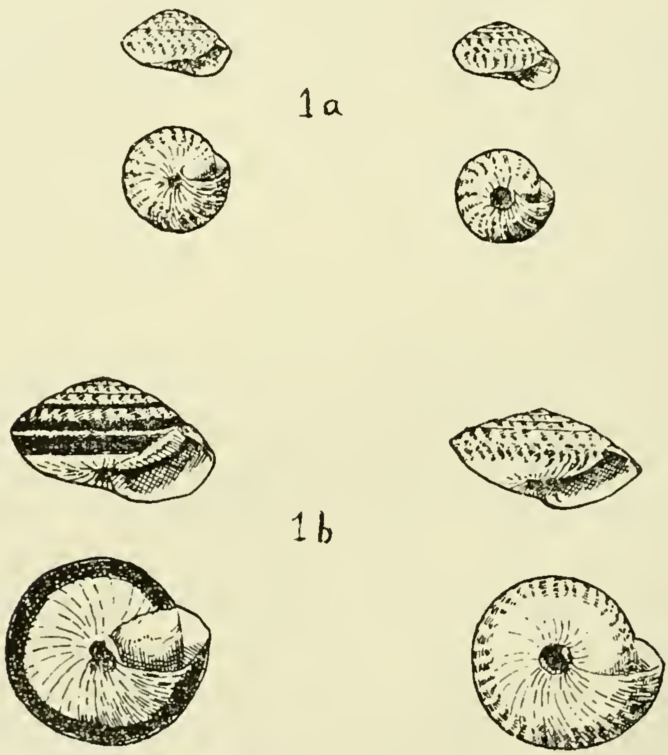

Fig. 1a (top four drawings). Apertural and umbilical views of *P. circumfirmatus* from Government Quarry, Graveyard Fissure (Locality 5, of Gould, 1969b) on left and from Tom Moore's Cave on right. I can find no major differences beyond those due to the wider umbilicus of Tom Moore's shells. The effect may be phenotypic.

Fig. 1b (bottom four drawings). Left: *P. bermudensis zonatus* from Government Quarry, Graveyard Fissure. Right: *P. bermudensis fasolti* from Tom Moore's Cave. Tom Moore's shells are more widely umbilicate, but they are also more weakly colored (persistent juvenile flames that do not coalesce into bands), thinner shelled (no parietal callus), lower and more triangulate in cross section, and with a different apertural shape. All these features characterize juvenile stages of *P. bermudenis zonatus,* and the Tom Moore's sample represents a paedomorphic population that is genetically distinct from *P. b. zonatus.* All specimens actual size.

labile characters modified in the same way in several taxa. The situation in *P. bermudensis* is different. The Tom Moore's shells belong to the paedomorphic subspecies *P. bermudensis fasolti,* while all other samples contain shells of the central stock, *P. bermudensis zonatus.* Differences between the two taxa involve many aspects of shell form—color, thickness, and shape (Fig. 1b) —and their geographic distribution meets the criteria of biologic subspecies (*P.b. fasolti* is a local population at the geographic periphery of the range of *P.b. zonatus*) . Moreover, the wide umbilicus of *P.b. fasolti* is an integral part of the paedomorphic character complex; it is not a separate feature that has undergone independent, environmental modification. The paedomorphosis itself is almost surely genetic (Gould, 1969b, pp. 478-479). Thus, the precise environmental control that produced wide umbilici at Tom Moore's Cave may have been direct (i.e. phenotypic) for some species and indirect for others (by setting the direction of natural selection) . If this interpretation is correct, it provides support for my previous assertion (Gould, 1968 and 1969b, pp. 482-483) that the adaptive significance of paedomorphosis, which occurred at least four times during the Pleistocene history of *P. bermudensis,* lies in the thin shell that it produces and that lime-poor habitats require.

Ackowledgments

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NEW HYDROBIIDAE FROM OZARK CAVES

By LESLIE HUBRICHT

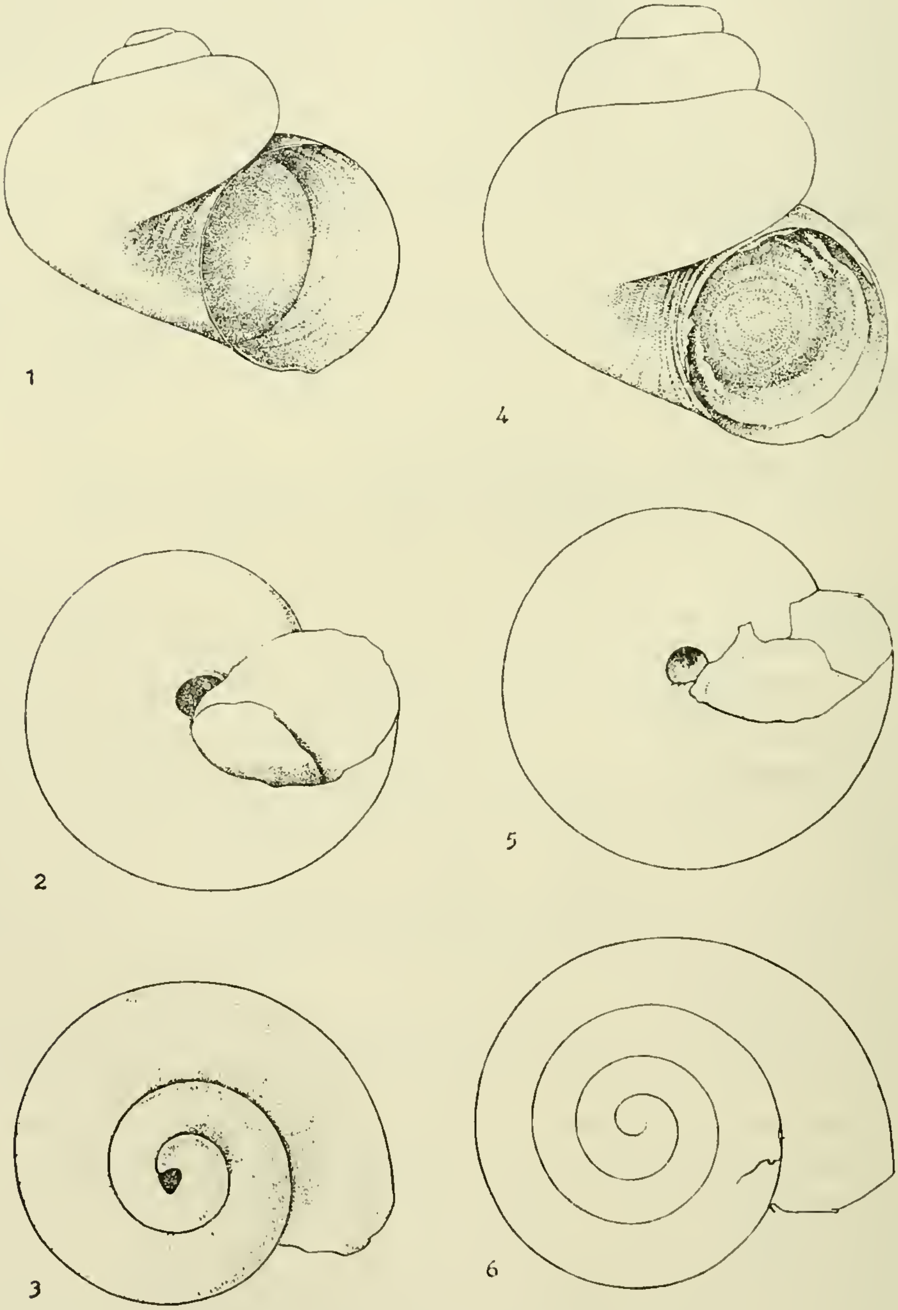
Amnicola stygia, *new species.* (Figs. 1, 2, 3)

Description—Shell small, broadly conic, thin and very fragile, opaque, straw-colored; whorls 3 to 3.5, well-rounded, the last whorl barely appressed to the preceding whorl, sutures very deep, nuclear whorl raised; umbilicus open, about one-sixth the diameter of the shell; aperture round, peristome continuous, barely attached to the preceding whorl or sometimes free, lip thin, slightly sinuous, columellar margin not reflected or bent. Operculum corneus, paucispiral, with about 3 whorls, nucleus a little below the center.

Animal white and blind, without any trace of eyes; verge bifid, rather stout; central tooth of the radula with 11 denticles on the reflection, one moderately large mesocone and 5 ectocones on each side; lateral tooth with 8 denticles, one rather large mesocone, 3 entocones, and 4 ectocones; marginal teeth with numerous small denticles.

Height 2.4 mm., diameter 2.7 mm., aperture height 1.0 mm., diameter 1.0 mm., umbilicus diameter 0.4 mm., 3.2 whorls. Holotype.

Distribution—Missouri: Perry Co: stream in Tom Moore Cave, 3 miles north of Perryville, holotype 164173 and paratypes 164172, Field Museum of Natural History, other paratypes 38750, collection of the author; stream in Berome Moore Cave, 3.5 miles northeast of Perryville (Stewart Peck, coll.). These two caves are part of one cave system. The same stream flows through both.



Figs. 1, 2, 3, *Amnicola stygia* Hubricht, holotype. Figs. 4, 5, 6, *Antrobia culveri* Hubricht, holotype.

Remarks—*Amnicola stygia* appears to be most closely related to *A. limosa* (Say), the verges being identical. The shell, however, is quite different. It is more depressed, being wider than high; with a more open umbilicus. The aperture is circular, and the shell has fewer whorls. In life the shells are coated with a thick black deposit.

Antrobia, *new genus*

Description—Shell small, conical, higher than wide, whorls 3.5, aperture roundly oval; peristome continuous, lip simple, columella not thickened; umbilicus open; operculum thin, subhyaline, paucispiral. Animal white and blind; verge simple, tapering to a point, without appendages, attached to the center of the back and lying on the right side, when at rest curled forward in nearly a full circle so that the tip rests at the center of the back near the point of attachment. Radula similar to that of *Amnicola* but the mesocone of the central tooth is not enlarged, being only slightly larger than the adjacent ectocones, there are 5 ectocones on each side and 2 basocones; lateral teeth with 8 denticles which are very similar in size; marginals with numerous very fine teeth; the denticles of the central and lateral teeth are about as long as wide and are blunt; the teeth of the marginals are slender and sharp.

Type species: *Antrobia culveri,* new species.

Antrobia culveri, *new species* (Figs. 4, 5, 6)

Description — Shell small, conical, pale-yellow, subhyaline; whorls 3.5, well-rounded, the last whorl lightly appressed to the preceding whorl, sutures deep, nuclear whorl depressed; umbilicus open, about 6.5 times in the diameter of the shell; aperture nearly round, peristome complete across parietal margin, adnate to preceding whorl; lip thin, sinuous, columellar margin straight, basal and outer margins well rounded; sculpture of many fine spiral lines; operculum corneous, paucispiral, with about 3.5 whorls, nucleus a little below and to the left of center.

Animal white and blind, without any trace of eyes, verge simple, tapering to a point, oval in cross section, attached to the center of the back and lying on the right side; central tooth of the radula with 11 denticles on the reflection, the mesocone only slightly larger than the adjoining ectocones, 5 ectocones on each side; lateral tooth with 8 denticles, 3 entocones, 1 small mesocone,

and 4 ectocones; marginal teeth with numerous small denticles.

Height 2.3 mm., diameter 2.0 mm., aperture height 1.2 mm., diameter 1.1 mm., umbilicus diameter 0.3 m., 3.5 whorls. Holotype.

Distribution—Missouri: Taney Co.: stream in Tumbling Creek Cave, 4.5 miles northeast of Protem (David Culver; Thomas Aley; L. Hubricht, colls.), holotype 164171 and paratypes 164170 FMNH., other paratypes 36263, 36840, 38780 collection of the author.

Antrobia culveri could not be readily confused with any other species of Hydrobiidae of the central United States. The only species with which the shell might be confused is *Amnicola stygia,* but in that species the shell is wider than high and the nuclear whorl is not depressed.

My thanks to Field Museum of Natural History, Chicago, for having Miss Claire Vanderslice, Illustrator in Lower Invertebrates, prepare the shell figures used in this paper.

THE ECOLOGICAL SIGNIFICANCE OF THYASIRA BISECTA CONRAD [1]

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Specimens of *Thyasira bisecta* Conrad have been reported from Cenozoic strata ranging in age from Eocene to Pleistocene in the northern Pacific (Taiwan, Japan, Sakhalin, Kamchatka, Alaska, Washington, Oregon, California). Because most of these occurrences are from dark-colored muddy rocks, this bivalve has generally been regarded as a deep-water species. Included herein are several records of living specimens of *T. bisecta* from the northwestern coast of North America and from the Japanese Islands. These data modify some of the earlier concepts of this species as an indicator of a deep-water environment.

Thyasira bisecta has great variation in shape, and some paleontologists have considered these variations as distinct species or subspecies, whereas others have considered all these variations in form as a single species. I have observed these variations in shape but am inclined to consider them as one species. Krishtofovich's (1936) "*Thyasira bisecta* group" is the same as my broad

[1] Submitted in honor of Leo George Hertlein; see vol. 84, no. 2, Oct. 1970.

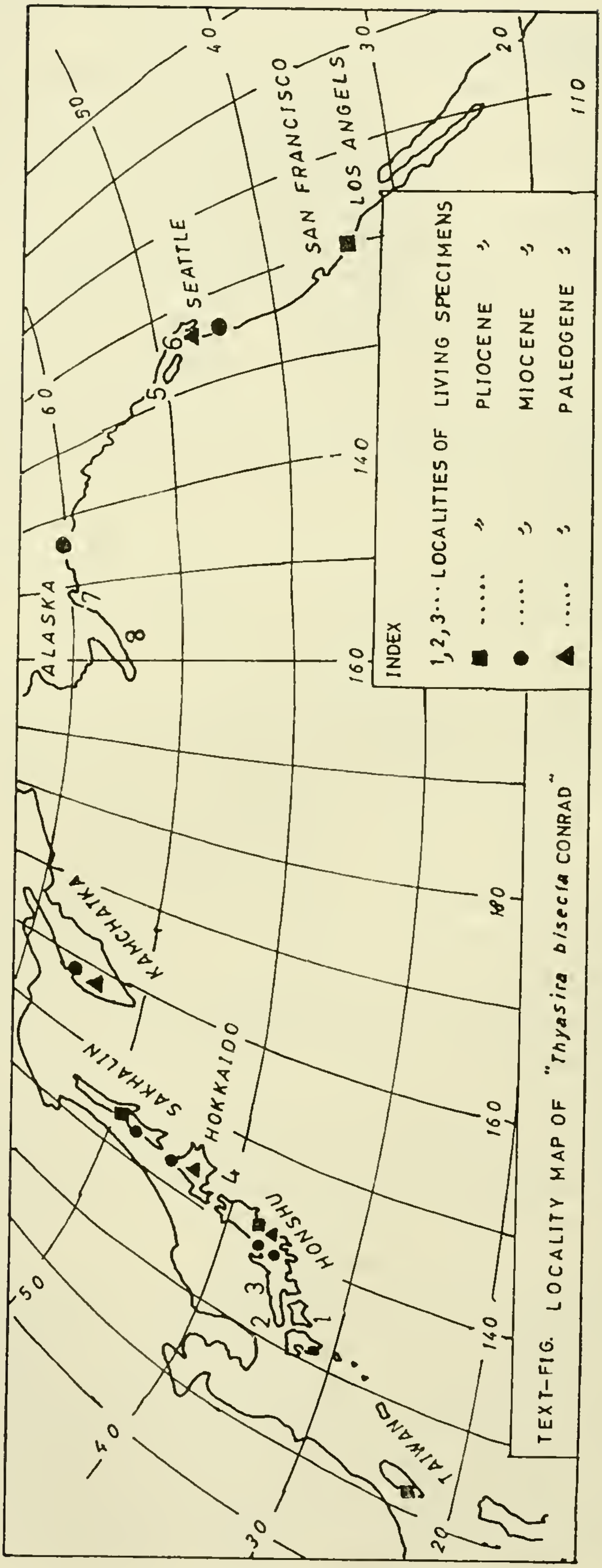
concept of *T. bisecta,* and I consider *Conchocele disjuncta* Gabb to be a synonym of *T. bisecta*.

Although those specimens taken from localities 5 and 7 were shore collections, they had some periostracum and the matching valves were intact. Specimens from locality 7 were collected from raised beach deposits caused by the uplift which accompanied the 1964 Alaskan Earthquake (Plafker, 1967). According to Plafker the locality in Macleod Harbor, Montague Island, was uplifted about 10 meters by the earthquake. Moreover, all specimens from locality 7 are articulated and in such fresh condition that they probably represent *in situ* living specimens. Thus, Recent specimens can inhabit depths of less than 10 meters where the average temperature is about 6.6°C in February and 12.5°C in August. No living specimens were collected off Shikoku and Cape Erimo, Japan (localities 1 and 4), but the valves are articulated with some periostracum (Kuroda, 1938; Habe, 1961).

The data in Table 1 show that *Thyasira bisecta* is commonly found on a mud or fine-sand substrate in water ranging in temperature from 1.5°C to 12.5°C. *T. bisecta* has a very great bathymetric range, from less than 10 meters to as much as 700 meters. This species is found in shallow water in boreal regions but is restricted to deep water in subtropical areas.

Recent, as well as fossil, specimens have some variation in form. Specimens from off Mishima Island (locality 2) have a large and quadrate form, whereas the others have a produced and oblique form. The specimens from locality 2 were the ones from which Nakajima (1958) made his anatomical study and are known as *Thyasira bisecta* var. *nipponica*. Parker (1964) has also found this variety off the island of Timor in the East Indies. The writer assumes that the geographical and bathymetrical distribution, as well as variation in size and shape, are to some extent affected by water temperature.

Fossil specimens of *Thyasira bisecta* are extremely variable in shape, and the greatest amount of variation is in the apical angle. These varietal forms and their intermediates commonly occur in the same geological horizon or even in the same outcrop (Makiyama, 1934; Kanno, 1960). Generally speaking, the type having an acute angle is rather common from the Paleogene and also from Pliocene to Recent, whereas the large quadrate form



TEXT-FIG. LOCALITY MAP OF "*Thyasira bisecta* CONRAD"

is rather common in middle and upper Miocene strata where *T. bisecta* attains its maximum size.

The first appearance of *Thyasira bisecta* is in the late Eocene or early Oligocene (Poronai formation) in Japan and in the Eocene (Tighil series) on the west coast of Kamchatka (Krishtofovich, 1936). The specimens from the Poronai formation are associated with *Akebioconcha ezoensis* (Yokoyama) in a biohermal deposit, and both *Akebiconcha ezoensis* and *Thyasira bisecta* occur in closely packed articulated valves. Both of these species are represented by shells of all growth stages. A few species of *Akebiconcha* are now living off central Japan, but they are restricted to rather deep water, ranging from 300 to 700 meters, and they occur in crowded shell colonies like *Akebiconcha ezoensis.* Kobayashi (1957) reported *Aturia yokoyamai* Nagao from the Poronai formation, and he pointed out that the occurrence of *Aturia* indicates warm surface water. Judging by these facts, the Poronai specimens of *Thyasira bisecta* seem to be inhabitants of deep sea bottoms where the surface water was rather warm.

The earliest occurrence of *Thyasira bisecta* in North America is late Oligocene in the zone of *Acila gettysburgensis.*

Most of the Miocene specimens from Japan occur in black muddy facies as do the Poronai specimens. They are associated with *Solemya, Portlandia,* and *Lucinoma.* It seems that the shallow-water marine climate off Japan was at least subtropical during the Miocene because of the occurrence of *Lepidocyclina* and *Cypraea* from equivalent shallow facies. Similar conditions may have occurred as far north as Sakhalin and Kamchatka. During the Pliocene *Thyasira bisecta* spread southward in both the eastern and western Pacific to California and Taiwan.

Localities with ecologic data where Recent specimens of *Thyasira bisecta* have been collected are listed below. See corresponding numbers on the distributional map.

1. Off Shikoku, Japan, Pacific Ocean (T. Habe, 1961).
   33°10'N; 133°30'E, ca. 700 m., ca. 9.8°C, 34.18% salinity.
2. Off Mishima, Yamaguchi Prefecture, Japan Sea, collected by Ito.
   35°27'N; 130°35'E, 230 m., soft mud, 1.5°C, 34.0% salinity.
3. Off Kasumi, Hyogo Prefecture, Japan Sea (Ito, 1967).
   35°44'N; 134°38'E, 225-350 m., ca. 34.0% salinity.

4. Off Cape Erimo, Hokkaido, Pacific Ocean (Kuroda, 1938). ca. 41°40'N; 143°15'E, 200 m., ca. 2.0°C.
5. Vancouver Island, Canada, collected by G. D. Hanna. 51°49'N; 127°28'W, fine sand, 6.5°-12.5°C, 32.0‰ salinity.
6. Puget Sound, Washington, collected by G. D. Hanna. ca. 48°N; ca. 122°40'W, 6.5°-12.5°C, 32.0‰ salinity.
7. Macleod Harbor, Montague Island, Alaska, collected by G. D. Hanna.
   59°53'N; 147°46'W, ca. 10 m., fine sand, 6.5°-12.5°C, 32.0‰ salinity.
8. South coast of Alaska Peninsula (Dall, 1895). ca. 55°N; ca. 155°W, ca. 140 m., mud, ca. 6.5°C.

Acknowledgments

I wish to express my thanks to Drs. Leo G. Hertlein and G. Dallas Hanna of the California Academy of Sciences for permission to study the specimens in their collection and for valuable information on the occurrence of *Thyasira bisecta* from Alaska and Puget Sound. I am indebted to Mr. K. Ito, Japan Sea Regional Fisheries Research Laboratory, for ecological data on Recent specimens collected from the Japan Sea. Much of this work was suggested by Drs. Warren O. Addicott, David M. Hopkins, and George Plafker of the U. S. Geological Survey, to whom I owe thanks for valuable ideas. I am also indebted to Prof. H. Niino and Mr. I. Fujiyama, Tokyo Museum of Natural History, for their help.

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ON SOME HELICINA FROM THE DOMINICAN REPUBLIC

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While attempting to determine a collection of land and fresh-water shells from the Dominican Republic, we found it was necessary to make the following rectifications in the nomenclature of certain helicinids of Hispaniola.

1. *Helicina (Helicina) castilloi* Clench & Jaume (1946, Rev. Soc. Malac. 'Carlos de la Torre', *4:* 7, text figs. 1-3) from Rancho Arriba, San José de Ocoa, Azúa, Dominican Republic is a junior synonym of *Helicina gabbi* (Crosse et Newcomb MS) Crosse (1873, Jour. Conchyl., *21:* 354; ibid., 1874, *22:* 87, pl. 1, fig. 4) from Samaná. The brown color of the type-figure of Crosse's description of *gabbi* occurs very frequently in recently collected specimens where we also find individuals of various shades of green, generally marked with reddish brown bands, dots, blotches or other kinds of ornamentation.

2. The status of the land prosobranch species *Helicina viridis* Lamarck, 1822, has been confused almost since the date of its first description. Much clarification was offered by Crosse (1890, *infra)* but some points still remained to be cleared up. Below is a brief account of the history of the taxon.

Lamarck (1822, Anim. Sans Vert., vol. 6 (2), p. 103) named *Helicina viridis* from Saint-Domingue [Hispaniola] in a short Latin description. The diameter was given as "2 lignes", or about 4 mm. As Crosse noted (1891, Jour. Conchyl., vol. 39, p. 190), Lamarck's type-specimen was an immature shell, a fact which explains the words "labro simplici, acuto" in the original description. This specimen, in spite of certain doubts expressed by

Crosse (1891) and Mermod (1951) (see below) is the one figured by Chenu in Delessert's "Recueil de Coquilles décrites par Lamarck" (1841, pl. 27, figs. 3 a-d), and photographed by Mermod (1951, Rev. Suisse Zool., vol. 58, p. 716, text fig. 70). These figures are of a green shell with, in the case of fig. 3a by Chenu, a white peripheral band ornamented by 10 brown dots which, in Mermod's opinion, were too vividly colored. There is in addition a brown spot on the apex. This brown ornamentation was not mentioned by Lamarck, but it could easily have been overlooked in such a small specimen. Although Crosse (1891) as well as Mermod (1951) criticized Chenu for some details of the drawing, the fact remains that *viridis* Lamarck is a small, green helicinid, ornamented in places by brown areas.

Gray (1825, Zool. Journ., vol. 1, p. 67) discussed a shell he thought to be *viridis* Lamarck. He gave the dimensions as 6/20 of an inch in axis [= height], and 11/20 of an inch in diameter, a much larger shell, as he admitted, than the immature one described by Lamarck. The figure (pl. 6, fig. 7), copied by Sowerby (1847, Thes. Conchyl., vol. 1, pl. 2, fig. 67), shows a green shell with a gently expanded outer lip and a slight peripheral carina. In 1866 Sowerby again produced a figure (Thes. Conchyl., vol. 3, pl. 276, fig. 379) as *viridis* which, as Crosse stated *(l.c.)* is completely unrecognizable. Sowerby also pictured a shell *(ibid.,* pl. 276, fig. 380) under the new name *Helicina aurantioviridis* which H. Cuming had sent him from the Sallé collection made in Santo Domingo. This shell had been called *H. viridis* by Sallé, but because it did not resemble the specimen figured by Gray, Sowerby decided that he was dealing with a new species. Pfeiffer (1851, Zeitschr. Malak., vol. 7, p. 77), laboring under the same misconception, had already named this presumably new species *Helicina versicolor.*

Crosse, in the meantime, had obtained a different species which he realized was the real *viridis* of Lamarck. He figured this species (1891, Journ. Conchyl., vol. 39, pl. 3, figs. 8a, 8b, 8c, 8d) and these figures coincide almost exactly with the holotype (MCZ 188267) and paratypes (MCZ 188268) of *Helicina juliae* Clench (1962, Breviora, no. 173, p. 2, pl. 1, fig. 2). Wagner (1910, Martini & Chemnitz, Conchyl.-Cab. (2), vol. 1, sect. 18, pt. 2, p. 321, pl. 64, figs. 8-11) also figured the same species from a somewhat

larger (6 mm.) but still immature specimen in the Berlin Museum. Crosse decided that the figures of the larger shell presented by Gray and Sowerby were, "sans valeur . . . qu'il convient de n'en tenir aucun compte" *(l.c.,* p. 190).

If this means that they are fanciful and based upon no real shells, Crosse's conclusion is in error. Through the kindness of Dr. Peake of the British Museum (Natural History) we were able to examine Gray's type. We saw that not only is it not *viridis* Lamarck, but is an apparently unnamed species. We will describe it below under the name *Helicina grayi.* We feel completely justified in doing this even with only the type-specimen before us for examination, because this seems to be the easiest way to clear up finally the problem of *viridis* Lamarck *et al.*

There remains little reason to doubt that the true Lamarckian species is the one figured by Crosse and by Mermod and named *juliae* by Clench. The brown spots overlooked by Lamarck and illustrated by Chenu, together with other types of brown markings, are found only on the specimens called *viridis* by Crosse; they are absent from the two larger species described below. Moreover, the smaller species is found not far from the environs of Santo Domingo City. It is most likely that Lamarck's specimen came from an accessible area not far from the capital city.

The synonymy resulting from the discussion above is as follows:

Helicina viridis Lamarck, 1822

Helicina viridis Lamarck, 1822, An. s. Vert., vol. 6 (2), p. 103, type-locality Saint-Domingue [Hispaniola]; type in Geneva Museum; Chenu, 1841 [in] Delessert, Recueil de Coquilles etc., pl. 27, figs. 3 a-d; Mermod, 1951, Revue Suisse de Zool., vol. 58, p. 716, text fig. 70.

Helicina viridis Lamarck. Crosse, 1891, Jour. Conchyl., vol. 39, pp. 188-191, pl. 3, figs. 8, 8 a-c; Wagner, 1910 [in] Martini & Chemnitz, Conchyl. Cab., (2), vol. 1: sect. 18, pt. 2, p. 321, pl. 64, figs. 8-11.

Helicina versicolor Pfeiffer, 1851, Zeitschr. Malak., vol. 7, p. 77, type-locality, Haiti; type probably destroyed.

Helicina aurantioviridis Sowerby, 1866, Thes. Conchyl., vol. 3, pl. 276, fig. 380; no locality given; type, BM (NH) 19706.

Helicina juliae Clench, 1962, Breviora, no. 173, p. 2, pl. 1,

fig. 2, type-locality, Colonia Ramfis, 20 km. W. of San Cristóbal, República Dominicana; holotype, MCZ 188267.

Helicina grayi Jacobson & Clench, ***new species***
(Figure 2)

Helicina viridis "Lamarck." Gray, 1825, Zool. Journ., vol. 1, p. 67, pl. 6, fig. 17 (not Lamarck).

Helicina viridis "Lamarck." Sowerby, 1847, Thes. Conchyl., vol. 1, pl. 2, fig. 67; 1866, Thes. Conchyl., vol. 3, pl. 276, fig. 379 (not Lamarck).

Holotype, BM(NH) 19705 (Santo Domingo = Hispaniola).

Description—Shell about 7 mm. in height, 12 mm. in width, carinate, depressed, rather fragile, translucent, sublustrous. Whorls 5, weakly convex, increasing rapidly in width, the last whorl half as wide again as the penultimate. Body whorl rounded below, sharply and narrowly carinate at the periphery, descending at the aperture where the carina slightly overhangs it. Color bluish green above the carina, lighter on the spire, the early post-nuclear whorls, keel, peristome, and parietal callus bluish white, with a small, yellow, irregular stain near the protoconch. Aperture oblique, semilunate, well-rounded but distorted at the periphery by the keel. Palatal lip slightly thickened, shortly expanded, merging basally in a rounded angle with the columella. Parietal callus thickened, lustrous, minutely and regularly punctate, bluish white in umbilical region, bounded parietally by a dark bluish green band which widens as it curves around the white portion and enters deep into the aperture along the upper half. Columella white, diagonal, lightly inflated above, shortly rounded below, terminating in a short, rounded thickening of the basal lip. Suture well-impressed. Sculpture of variously strong, diagonal growth lines only, surface minutely punctate. Lineolations inside the shell substance not distinct, separated by narrow intervals, irregularly sinuous. Protoconch 1½ whorls, white with irregular yellow blotch at the suture, minutely punctate. Periostracum thin, strong, glossy. Operculum unknown.

height	width
11.2 mm.	7.1 mm.

Remarks—This specimen was figured by both Gray (1825) and Sowerby (1847) in somewhat exaggerated colors. A keel is not

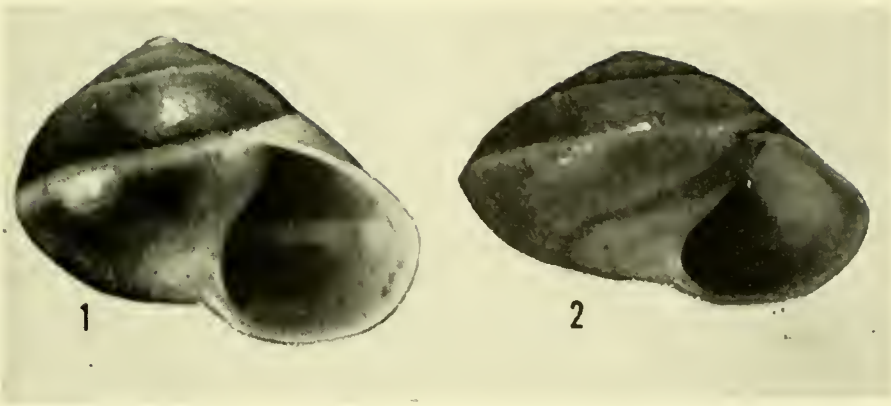


Fig. 1. *Helicina prasinata* Jacobson and Clench, *new species*, Holotype, 9.6 mm. in height. Fig. 2. *Helicina grayi* Jacobson and Clench, *new species*. Holotype, 7.1 mm. in height.

unusual in Neotropical *Helicina* but *H. grayi* differs from the other keeled forms (*heati* Pfeiffer from Grenada, *amoena* Pfeiffer from Mexico and Central America, *salleana* Gray from Mexico, and *neritella* Lamarck from Jamaica) in the more acute carina, the greenish blue color, the fragile shell texture, the more depressed outline, and the relatively smaller size. It is closest to *Helicina cruciata* Weinland 1880, but differs in being about twice as large, in possessing a green instead of reddish (rubella) color, in having a relatively smooth instead of a decussated surface, and in lacking the basal labial tooth.

Gray's label in BM (NH) bears the words "S. Domingo & Cuba," but someone drew a line through the word "Cuba." As far as is known, no Cuban *Helicina* resembles *grayi*.

3. Another undescribed *Helicina* from the Dominican Republic partially formed the basis for the remarks made by Clench & Jaume (1946, Rev. Soc. Malac., vol. 4, p. 8), and Clench (1962, Breviora, no. 173: 2). The shells of this species differ considerably from the type of *grayi*, especially in color and in the absence of the peripheral keel. We introduce them as *Helicina prasinata* new species.

***Helincia prasinata* new species**

Figure 1

Helicina viridis "Lamarck." Clench & Jaume, 1946, Rev. Soc. Malac., vol. 4, p. 8; Clench, 1962, Breviora no. 173, p. 2 (not Lamarck).

Holotype, MCZ 187927, Monteado Nuevo, 20 km. S.E. of Polo, Barahona Province, Dominican Republic. R. A. Howard leg.

Paratype, MCZ 90683, Loma Vieja, Constanza, La Vega Province, Dominican Republic. P. J. Darlington, legit.

Description—Shell reaching about 12 mm. in diameter, rather thin, smooth (depressed turbinate, white or pale yellowish green under a strong, green, glossy periostracum. Whorls about 5, barely inflated, earlier whorls slowly increasing in width, but body whorl more than twice as wide as the penult, moderately rounded, descending shortly at aperture; base slightly inflated. Color of the glossy periostracum bright, grass-green, somewhat lighter and a bit olivaceous below, with a white subperipheral band; lip and basal callus greenish white. Aperture oblique, widely semilunate, white internally with the subperipheral band showing through. Palatal lip gently but distinctly expanded, less so at either termination, narrowly reflected near columella where it has a very low, tooth-like protuberance. Parietal area with an irregular, glossy wash, pale yellowish green or white, not raised. Columella diagonal, evenly and widely rounded below, slightly convex above. Suture weakly impressed with a very narrow, weakly delimited, white band at summit of the whorls. Sculpture of fine, diagonal growth lines crossed by numerous, closely set, subequidistant spiral cords, obsolescent on the base. Protoconch 1½ whorls, rounded, minutely pitted, light yellowish green, barely raised above succeeding whorls. Periostracum strong, glossy, bearing the green color. Operculum thin, light buff, translucent, with a slightly raised, marginal ridge on the inner edge.

height	width	
9.6 mm	11.7 mm	Holotype
9.7	12.3	Paratype

Remarks—The shells of this new species can be confused with those of *Helicina gabbi* Crosse, but are readily distinguished from the latter by their smaller size, less solid substance, and especially the distinctly expanded lip. In the two specimens of the type-lot the only color seems to be either grassy or olivaceous green with a greenish-white subperipheral band; the vivid reddish or brown color found in so many specimens of *gabbi* and in the smaller *viridis,* is absent or appears as a slight tinge which renders the green on the base somewhat olivaceous. The parietal callus of *gabbi* is relatively larger, raised, and more sharply delimited. The closely set, narrow spiral cords of *prasinata* are

absent in *gabbi*. The new species is larger than *viridis* Lamarck and is furthermore distinguished by its lack of brown color and its more flaring lip. The green color of *prasinata* resembles that of *Papuina pulcherrima* Rensch from Manus Island, Bismarck Archipelago. From its shape, texture, and flaring lip, the new species seems to belong in *Helicina s. s.*, the type-species of which is *H. neritella* Lamarck from Jamaica.

The trivial name of the new species is based upon the Greek word for green.

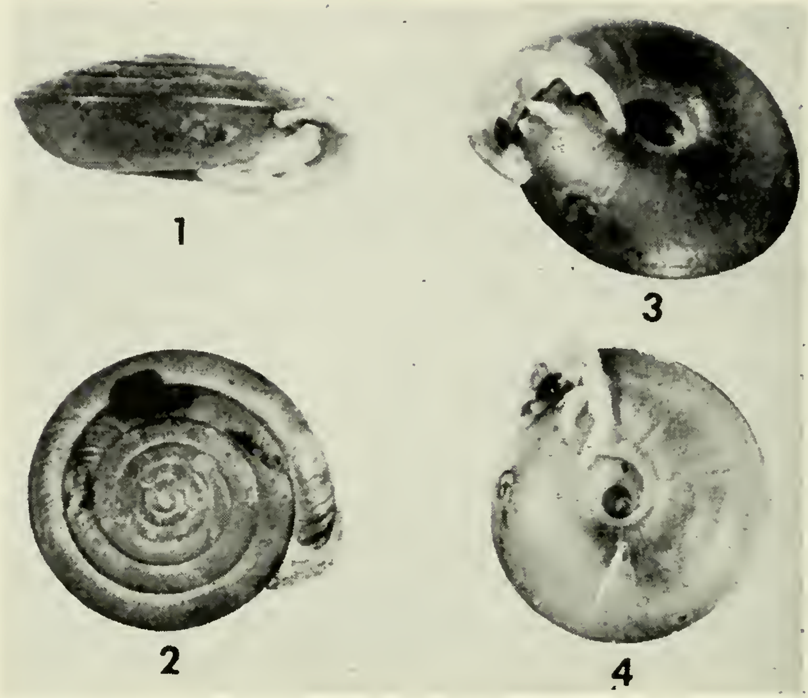
4. Clench & Jaume (1946, Rev. Soc. Mal., vol. 4, p. 8) listed some localities for *Helicina viridis*. Upon examining the lots in the MCZ upon which these data are based, we find that the specimens should be referred to *H. gabbi*. The localities where the true *viridis* is found are the ones given for *juliae (q. v.)*.

A NEW SPECIES OF ASHMUNELLA FROM THE DAVIS MOUNTAINS IN WEST TEXAS

By E.P. CHEATUM
Biology Department, Southern Methodist University, Dallas, Texas 75222

Ashmunella mudgei, *new species.* Figs. 1-4.

The glossy upper surface of this tannish-colored shell is slightly convex with the upper margin of the basal whorl carinated. The embryonic whorl is ornamented with fine delicate striae which on the protoconch are rather diffuse, then becoming regular with a beaded effect. Progressing from the embryonic whorl outward the striae become more conspicuous and the growth lines on the basal whorl are slightly coarser with a series of elevated ridges topped with white just back of the peristome. The lip is reflected outward and upward thus producing a wide, deep groove just back of the lip. The shell's umbilicus is contained slightly over 4 times in the shell diameter. The lower surface of the basal whorl is glossy with fine striae that extend from the carinated margin down into the umbilical region. Upon the parietal wall is an erect tooth slightly curved and shouldered at its proximal and distal ends, the proximal end continues as a distinct callus which is deflected toward the insertion of the outer lip. On the upper part of the parietal wall and slightly within the aperture is a rather short, shallow, straight dome-shaped tooth. Within the inner basal lip are two erect teeth pro-



Figs. 1-4. *Ashmunella mudgei* Cheatum, *new species.* Holotype, 16.9 mm. in diameter.

ducing a deep horseshoe-shape cleft between the teeth, the outer of these teeth is slightly concave on its outer surface. Within the outer lip is an elongated ridge-like tooth which is in length the approximal distance (2.5 mm.) between the inner and outer margins of the lower palatal teeth. The conspicuously reflected outer lip is a glossy white, except for its outer end which has a faint pinkish tint. A buttressed base is evident at the point where the outer lip meets the basal whorl. Six and one-half whorls.

	Diameter	*Height*	
Holotype	16.9 mm.	7.3 mm.	Dallas Museum Nat. Hist. 0087
Paratypes	16.6 mm.	6.3 mm.	Dallas Museum Nat. Hist. 0087A
	17.5 mm.	7.8 mm.	Dallas Museum Nat. Hist. 0087A
	15.7 mm.	6.9 mm.	Dallas Museum Nat. Hist. 0087A
	15.6 mm.	6.9 mm.	Dallas Museum Nat. Hist. 0087A
	15.6 mm.	7.2 mm.	Dallas Museum Nat. Hist. 0087A
	15.7 mm.	6.9 mm.	Dallas Museum Nat. Hist. 0087A

Comments—This new species of *Ashmunella* has been named for Mr. Ned Mudge, naturalist-philanthropist, and benefactor of Southern Methodist University and the Dallas Museum of Natural History. This new species was collected on a snail-collecting

expedition to the Trans. Pecos of Texas. The trip was sponsored by the Dallas Museum of Natural History. Accompanying the writer was Mr. Hal Kirby, Director of the Museum and Mr. Richard Fullington, Curator of Invertebrates at the Museum.

The type locality is about half-way up in an unnamed canyon on the south slope of Sawtooth Mountain in the Davis Mountain range at an altitude ranging from 5000 to 6000 feet. The majority of the shells collected were found in pack rat nests. Since the collection was made during the month of November, the snails were hibernating and as a consequence our search for living animals was fruitless. Only two shells were found that had retained the original color; the others found in the nests of pack rats were bleached.

Ashmunella mudgei of the Mearnsi Group shows a close resemblance to *Ashmunella bequaerti* Clench and Miller (1966) which comes from the Davis Mountains. Shells of *bequaerti* given me by Lloyd Pratt of the Fort Worth Museum of Natural History, who collected them in Goat Cave Canyon on the Black Mountain of the Davis Mountains, and paratypes loaned me by MCZ and also collected in Goat Cave Canyon, exhibit a marked similarity in the shape and position of the parietal and palatal teeth. However, *bequaerti* is a much smaller species with the average diameter of shells I have examined not exceeding 12 mm. and a height of 3.6 mm. The periphery of the basal whorl in *bequaerti* is more sharply carinated and extended than in *mudgei;* the striae on the upper surface approach a rib-striate appearance and pustulate whereas in *mudgei* the upper surface is glossy and the striae much more subdued. In *bequaerti* the parietal teeth of the shells which I have examined, rest upon a thin white callus, whereas in *mudgei* this callus is absent. The number of whorls in *bequaerti* is 6 whereas there are 6½ whorls on the average in *mudgei.*

Grateful acknowledgment is due Dr. William Clench of the Museum of Comparative Zoölogy for confirmation of this species.

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ATHEARNIA, NEW NAME FOR A GENUS OF PLEUROCERID SNAILS.

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The name *Eurycaelon* of Lea (1864, p. 3) has been incorrectly used for a number of years. Bryant Walker (1918, p. 36), Thiele (1929, p. 193), Calvin Goodrich (1931, p. 3), Wenz (1939, p. 700) and Morrison (1952, p. 7: 1954, p. 362), all used this name with *Anculosa anthonyi* Redfield as the type species, "by subsequent designation by Walker". Contrary to the statement of Wenz, Tryon (1883) gave no type designations.

In fact, Nevill (1885, p. 205) had previously designated *Goniobasis umbonata* Lea (1864, p. 3), the first species described under the name, as the type species of *Eurycaelon*. This species was also recorded as the type species by Hannibal (1912, p. 168), although his identification of *umbonata* was erroneous. Critical examination proved to me thirty years ago that the holotype of *Goniobasis umbonata* Lea (U.S.N.M. #119657) is a specimen of *Pleurocera geniculata* Haldeman 1840 from the Cumberland River, with the lower portion of the aperture imperfect, in the process of additional growth. In other words, *Eurycaelon* Lea 1864 is biologically synonymous with *Pleurocera* Rafinesque 1818, and with *Lithasia* Haldeman 1840.

The synonymy is:

Pleurocera Rafinesque 1818, fixed on *Pleurocera verucosa* Raf., by monotypy in 1820.

Lithasia Haldeman 1840, with the type species *Lithasia geniculata* Haldeman 1840, by original monotypy.

Eurycaelon Lea 1864, with the type species *Goniobasis umbonata* Lea 1864, by subsequent designation by Nevill 1885.

The generic name here proposed is *Athearnia,* to include the two species, *Anculosa anthonyi* Redfield 1854 from the Holston and Tennessee Rivers, and *Anculosa crassa* Haldeman 1842 of the Clinch River. It is given in honor of Herbert Athearn, who re-discovered the type species *anthonyi* Redfield living in northwest Georgia more than ten years ago. Tryon (1873, p. 348) recorded it from "west Georgia." It was still living in South Chickamauga Creek, 7 miles N.N.W. of Ringgold, Catoosa County, Georgia, on May 16, 1960. In a small way, this will

honor Athearn's continuing efforts to complete the study of the remaining Tennesseean Molluscan fauna before it is "improved" and/or polluted out of existence.

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NEWS

The Fourth Annual Meeting of the WESTERN SOCIETY OF MALACOLGISTS will be held at Asilomar, Pacific Grove, California, June 16th to 19th, 1971. Executive Board members for the year are: President, Dr. Eugene V. Coan; First Vice-Presi-

dent, Mrs. Beatrice Burch; Second Vice-President, Dr. Warren O. Addicott; Secretary, Mrs. Mary D'Aiuto; Treasurer, Mr. Ralph O. Fox; Members-at-Large, Mr. Barry Roth and Dr. James H. McLean; Three Past Presidents, Mr. David K. Mulliner, Dr. William K. Emerson, and Dr. Myra Keen.

Inquiries about the meeting and applications for membership should be sent to the Secretary, Mrs. Mary D'Aiuto, 804 Fielding Drive, Palo Alto, California—94303.

The Fourth European Malacological Congress will be held in Geneva, Switzerland, from September 7 to 11, 1971. It will follow a one-day meeting of museum curators in charge of Molluscs, devoted to the discussion of curatorial problems and collaboration. The meetings will take place in the new Museum of Natural History and eventually also in the University buildings. All malacologists are cordially invited. Accommodation will be arranged by the Tourist office in hotels and the Student hostel. Congress fee is S.Fr. 30.— (about $7.—) for members and corresponding members of U.M.E., S.Fr. 40.— (about $9.—) for non members, S.Fr. 15.— (about $3.50) for students and accompanying persons.

If you are interested and have not received the circulars, please contact the president, Dr. E. Binder, for more detailed information: IV European Malacological Congress, Museum of Natural History, CH- 1211 Geneva 6, Switzerland.

Ernst Marcus, marine zoologist and professor at the University of Sao Paulo, Brazil, died on June 30, 1968. He was born in Berlin on June 8, 1893, and emigrated to Brazil in 1936. He published extensively on Bryozoa, turbellarid worms and mollusks. Many of his papers were done jointly with his wife Eveline, whom he married in 1924, and who continues their research on the opisthobranchs. A biobibliography was published in vol. 108, Atti Soc. Ital. Sci. Nat. Museo Civ. St. Nat. Milano, Dec. 1968.

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Delaware Museum of Natural History, Greenville, Del. 19807

CHARLES B. WURTZ, *Biology Department*
La Salle College, Philadelphia, Pa. 19141

CONTENTS

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THE NAUTILUS

Vol. 84 April, 1971 No.4

HORACE BURRINGTON BAKER, 1889-1971

We regret to announce the death of Dr. H. B. Baker, Editor Emeritus, on March 11, 1971, in Havertown, Pa. An obituary will appear in the next issue.

A DEEP WATER *OMALOGYRA* IN THE WESTERN ATLANTIC

By Donald R. Moore

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In a recent paper, Bullock (1969) reported another find of the microgastropod, *Omalogyra atomus,* from the New England coast. This is a fairly well-known shallow water species in western Europe which has also been found on the coasts of Iceland, Greenland, and, rarely, from the northeastern United States. It is not well known, however, that a deep water species (*Omalogyra densicostata* Jeffreys, 1884) has been reported from two widely separated western Atlantic localities.

O. densicostata was described (Jeffreys, 1884) from two specimens collected by the "Porcupine," station 16 and 17a, in 600 to 1095 fathoms (1098 to 2002 m), off the coast of Portugal. These two specimens were figured. A third specimen, collected by the "Bulldog" in 1622 fathoms (2967 m) on the continental slope off Labrador was also included in the original description. Additional specimens from the western Atlantic were reported from off the West Indian island of Culebra in 390 fathoms (715 m) from the "Challenger" expedition dredgings (Watson, 1886).

The "Bulldog" specimen was kept by Jeffreys, and went to the U. S. National Museum when the Jeffreys collection was purchased

Contribution No. 1183 from the University of Miami, Rosenstiel School of Marine and Atmospheric Sciences, 10 Rickenbacker Causeway, Miami, Florida.

by the Smithsonian Institution. When examined by the writer, this specimen was found to differ from Jeffreys figures and descriptions as follows:

The axial ribs on the "Bulldog" specimen are not crowded since the spaces in between are wider, at least on the inner part of the whorls. The description of *O. densicostata states* "sculpture, extremely numerous and close-set striae in the earlier and middle stages of growth, which ultimately disappear and become microscopic lines; the upper part of the periphery as well as the base of the shell are encircled by a sharp keel which intersects the spiral striae." The "Bulldog" specimen has a weak spiral keel on either side between suture and periphery; the ribs inside the keel are not as numerous as on the outer portion of the shell. For each inner rib, there are two or three outer ribs.

Jeffreys apparently did not examine the "Bulldog" specimen as carefully as the others, and so missed the different sculpture. However, this is also true of Dall (1927), for he described another specimen from the western Atlantic without noticing the peculiar sculpture. This specimen came from "Albatross" station 2668, 30°58′N, 79°38′W, 294 fathoms (538 m), off Fernandina, Florida. Dall placed his specimen in the genus *Lippistes,* and stated that "the shell may not be mature." This species was only briefly described, and never illustrated. An amplified description is given below.

Omalogyra planorbis (Dall, 1927)

Lippistes planorbis Dall, 1927, p. 131.

Description—The shell (1.3 mm.) is planispiral and looks like a minute ammonite. The protoconch is equally visible on both sides, and the sculpture is also identical on both sides.

The protoconch is initially somewhat bulbous and consists of one whorl. The teleoconch is another one and one-half whorls. The suture is deeply impressed and the axial ridges project inwards a little beyond the suture. The sculpture consists of numerous axial ridges. Halfway out to the periphery, these ridges branch two or three times. There is a weak discontinuous keel formed where the branching occurs. The ridges disappear as they approach the periphery, and this region is quite smooth.

There are about 40 axial ridges on the inner part of the teleoconch. Some of the branched ridges on the outer part of the shell are indistinct, making a count difficult.

Holotype—U.S.N.M. No. 108091. Maximum diameter, 1.36 mm, height, 0.62 mm.

Type Locality—30°58′N, 79°38′W; depth, 294 fathoms (538 m).

Remarks—The type is broken around the aperture, and is somewhat worn. The sculpture on the inner part of the whorl is, however, well preserved. The shell is white in color without any trace of color pattern although it might originally have been some shade of brown like other species in the family Omalogyridae.

The resemblance of the specimen to an ammonite is striking. Not only is it planispiral with each side a mirror image of the other, but the peculiar type of sculpture is also found in many species of ammonites. The shape of the shell reflects the way of life of the Omalogyridae, for the shell is not carried with the under surface resting on the foot. Instead, the shell is carried with the aperture directed forward, and with the plane of the coiling aligned in an anterior-posterior direction. Thus, the entire animal appears to be bilaterally symmetrical when crawling.

The holotype is slightly larger than the "Bulldog" specimen, and has a somewhat larger protoconch. It also appears to have finer sculpture, but, since the holotype is worn, this feature is difficult to evaluate. Since there were only two specimens to compare, the amount of specific variation is unknown. The two specimens are very similar in size and shape, and have the same type of sculpture. They should be considered conspecific until additional material makes it possible to determine the range in variation of the species.

Clarke (1962) overlooked the "Bulldog" specimen when he tabulated the list of mollusk species known from depth of more than a thousand fathoms. Actually, he probably should have included *O. densicostata* on the basis of the European specimens since Jeffreys gave the following locations for his species: Sta. 16—39°55′N, 95°6′W, 994 fathoms; Sta. 17—39°42′N, 9°43′W, 600 to 1095 fathoms. The second locality is given as sta. 17a, but no statement was made as to the precise depth at which this dredge haul was made.

The specimens of *O. densicostata* reported from "Challenger" station 24 in 390 fathoms off the island of Culebra, between Puerto Rico and the Virgin Islands, are possibly another species. Watson had a keen eye for detail on small species, and would hardly have missed the odd sculpture found on the specimens discussed above. In addition, his specimens must have been very small from his statement on the size of his material. A more likely record for *O. densi-*

costata is that of Dautzenberg (1889) for the Azores. However, his material was from shallow water, and may represent still another species. Nordsieck (1968) has synonomyzed *O. densicostata* with *Ammonicera fischeriana* (Monterosato, 1869), apparently with no justification whatsoever. The description and figures of *A. fischeriana* by both Monterosato (1869) and Vayssière (1893) differ considerably, except in size, from *O. densicostata.* The figure of *O. simplex* (Costa, 1861) is, however, very close to that of *O. densicostata* and probably represents the same species.

Tryon (1887) only added to the confusion surrounding the species. He gave the locality of the "Bulldog" specimen as "off Newfoundland" when the locality is actually due east of Jack Lane Bay, Labrador, and is nearly 300 miles north of Newfoundland. Tryon also synonomyzed *O. densicostata* with *Skenea trilix* Bush, 1885=*Cyclostremiscus pentagonus* (Gabb, 1873), a very different species belonging to the Vitrinellidae.

Omalogyra planorbis (Dall) is thus a rather deep water species of the family ranging from 294 to 1622 fathoms (538 to 2967 m). Its known distribution is on the continental slope of the western North Atlantic from 30°58′N to 55°36′N. Too little material is known at present to be able to say anything concerning the species physical requirements as to temperature, type of bottom, and so forth. Both localities, however, are well out to sea, so it is highly unlikely that the specimens came from shallow water. The high latitude of the "Bulldog" specimen appears to rule out the possibility that the specimens came from drifting seaweed. The species seems to be another mollusk that is poorly known mostly because of its small size.

Acknowledgements: I would like to thank the personnel of the Division of Mollusks, U.S. National Museum, for many courtesies and assistance in my research. This work was supported by National Science Foundation Grants GB-5055 (UM 8753) and GB-8284 (UM 8214). The excellent figure was drawn by Mrs. Barbara Lidz Miller.

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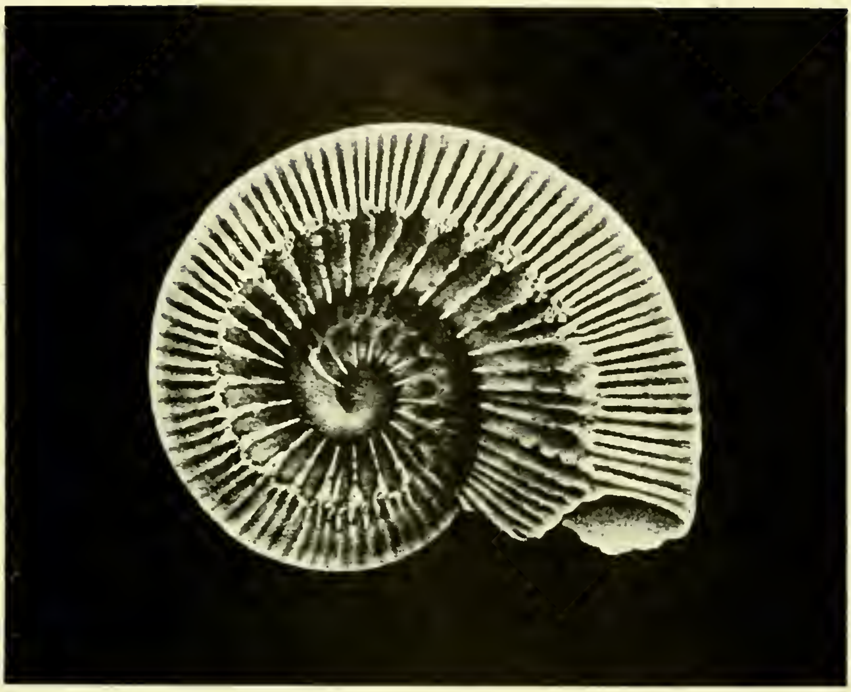

Fig. 1. *Omalogyra planorbis* (Dall). Holotype, 1.36 mm in major diameter, from off the east coast of north Florida.

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A SCANNING ELECTRON MICROSCOPE STUDY OF THE MARGINAL TEETH OF *NERITA PELORONTA* LINNAEUS

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The extreme range of magnification, high resolution and depth of field of the scanning electron microscope permit study of the molluscan radula with greater detail than has been previously possible by viewing dried radulae or stained balsam preparations with light microscopy.

Gastropods of the family Neritidae (Prosobranchia) are characterized by a radula containing numerous marginal teeth per row, as is typical of rhipidoglossate radulae. These teeth have been described by H. B. Baker (1923) in his extensive study of neritid radulae in which he observed marked differences in marginal teeth within a species. Only a few marginals from several species of *Nerita* s.s. were illustrated in his paper. Only one type of marginal tooth was drawn for *N. peloronta,* although Baker described the presence of teeth with cusps, as well as teeth without cusps, in this species.

Russell (1941) gave a more complete description of *N. peloronta* marginals. He distinguished between inner marginals (no cusps), middle marginals (with about 20 fine cusps which become approximately 34 coarser and longer denticles), and outermost marginals (20 fine denticles). Again, however, no teeth were figured. The present study was undertaken to examine the marginal teeth of *N. peloronta* and to determine the occurrence and morphology of cusps on these teeth.

Innermost marginal teeth (Fig. 2) were found to lack cusps, as described by Russell and Baker. These teeth are distally narrow and wide basally.

Teeth located in the middle portion of a row of marginals become cuspate, each tooth bearing about 10-15 large cusps (Fig. 3) which become smaller and more numerous in teeth further towards the most lateral area of the row. These teeth are spatulate and broader distally than are the innermost marginals. Outermost marginals consist of a broad, spatulate distal region containing many fine serrations (Fig. 4).

Close examination of the marginals of *N. peloronta* revealed

Contribution No. 1328 from the University of Miami, Rosenstiel School of Marine and Atmospheric Science, Florida 33149.

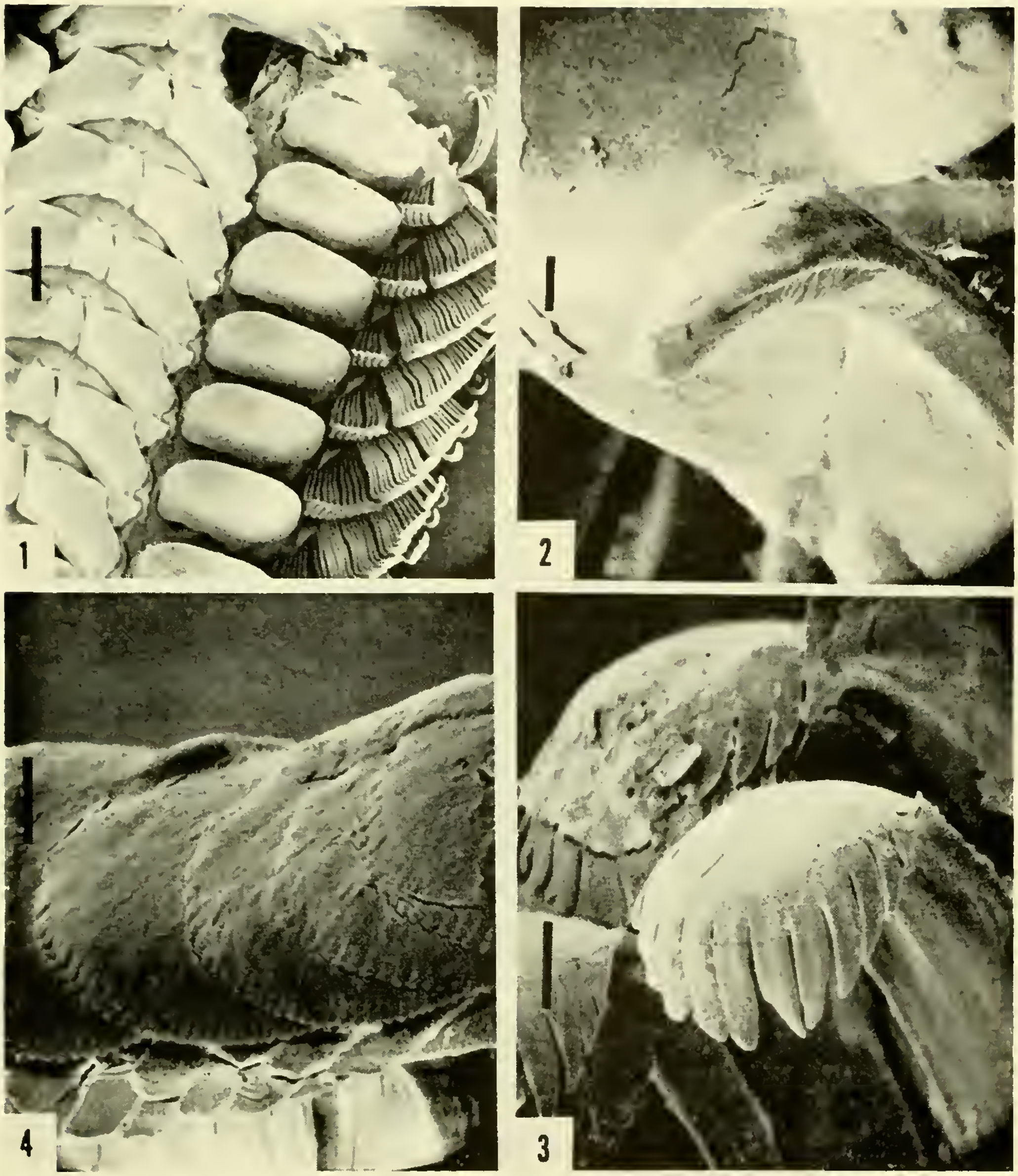

Fig. 1. One-half of a radular row of *N. peloronta*. Scale line equals 0.2 mm. Fig. 2. Innermost marginal. Scale equals 10 μ. Fig. 3. Middle marginal. Scale equals 5 μ. Fig. 4. Outermost marginal. Scale equals 5 μ.

that the innermost marginals are acuspate. Middle and outermost marginals possess cusps which vary greatly in size and number. There is not a clear separation into middle and outermost marginals; rather there is a gradual increase in number of cusps depending on the position of the tooth within the radular row.

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A NEW *ASHMUNELLA* (POLYGYRIDAE) FROM DOÑA ANA COUNTY, NEW MEXICO

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Reported here is a new species of snail of the genus *Ashmunella* from Mount Riley, Doña Ana County, in south-central New Mexico. Mount Riley is located approximately 30 miles west of El Paso, Texas, and 33 miles southwest of Las Cruces, New Mexico. "Mount" Riley actually consists of two mountains (herein called Northeast Mt. Riley and Southwest Mt. Riley in reference to their relative positions) located mainly in the southwest part of T. 27 S, R. 2 W. Northeast Mt. Riley (mainly in Secs. 29 and 30) com-

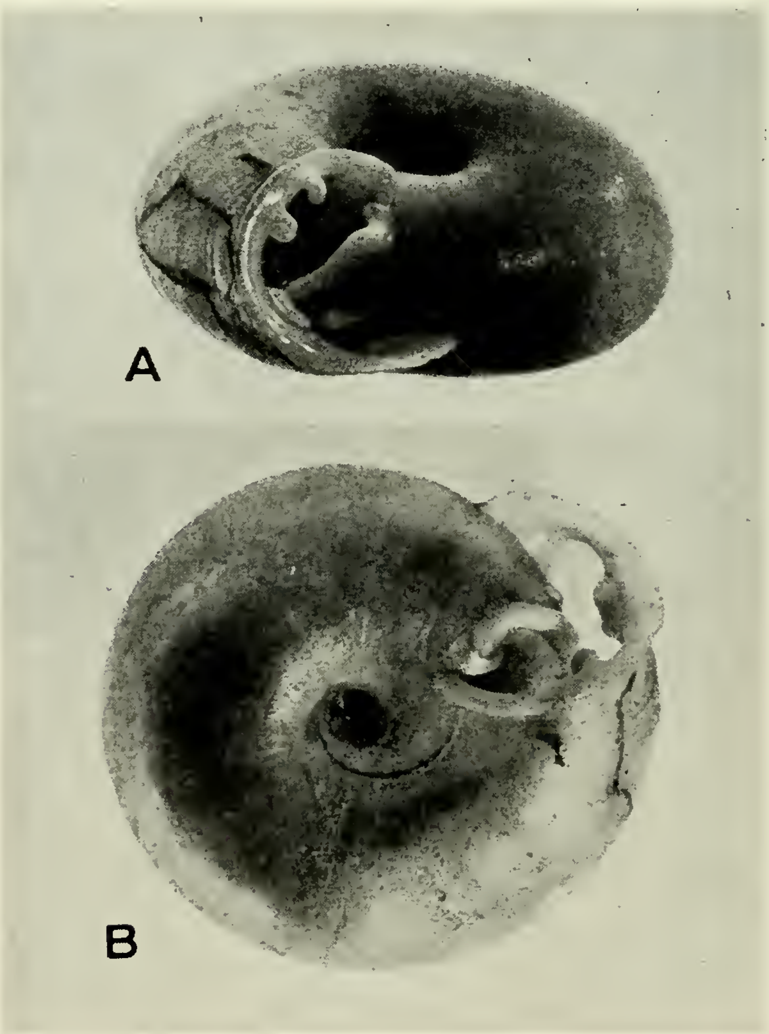

Fig. 1. Holotype of *Ashmunella rileyensis* new species, Mount Riley, Doña Ana Co., New Mexico (ANSP 319120).

prises a major peak (5915 ft.) in its southern part and, north of a low (5160 ft.) saddle, a series of four peaks ascending stairstep-wise to the highest, northwesternmost peak (5803 ft.). A valley *ca.* one-half mile wide separates Northeast Mt. Riley from Southwest Mt. Riley (mainly in Sec. 31), which is smaller, more conical in shape, and with only one major peak (5957 ft.), which is centrally located.

The only trees in the mountains are scattered one-seeded junipers (*Juniperus monosperma*). Salient larger plants include broad-leaved yuccas (*Yucca baccata* and *Y. torreyi*), sotol (*Dasylirion wheeleri*), several kinds of cacti, ocotillo (*Fouquieria splendens*), sumacs (*Rhus microphylla* and *R. trilobata*), and saltbush (*Atriplex canescens*).

In general, the same kind of rock is found throughout the mountains. The rock is igneous and fine-grained, possibly a dacite (Dr. Jerry M. Hoffer, pers. comm.). Dane and Bachman (1961) mapped Mt. Riley as consisting of extrusive rock of Tertiary age. The rock produces large amounts of talus, which has accumulated on slopes, especially at the heads of ravines in the mountains. All *Ashmunella* (except fossils) were taken by digging in this talus. A slope-wash mantle, probably of late Pleistocene age, has accumulated on the lower parts of some steep slopes. This sediment yielded a few fossil *Ashmunella* at Locality 5 (see below).

The new species was taken at the following localities shown on the Mt. Riley 15 minute topographic map, edition of 1929. All are in T. 27 S, R. 2W.

1. Northeast Mt. Riley. SW¼,SW¼,SW¼, Sec. 28. From talus on east slope of mountain. 5200-5300 ft.

2. Type locality. Northeast Mt. Riley. SW¼,NE¼, Sec. 30. From talus at head of southwest-draining ravine between 5803 ft. peak and next peak (5260 ft.) to the northwest; 3 mm NE of "0" in "30" on topo. map. *ca.* 5200 ft.

3. Southwest Mt. Riley. NE¼,SE¼,NW¼, Sec. 31. From prominent talus accumulation on steep north slope of mountain to south of intermontane valley. 5100-5200 ft.

4. Southwest Mt. Riley. SW¼,NE¼,SW¼, Sec. 31. From talus at head of west-draining ravine on west side of highest peak. *ca.* 5200 ft.

5. Southwest Mt. Riley. NE¼,NE¼,NW¼, Sec. 31. Reddish slope mantle exposed in arroyo bank towards lower part of steep

north-facing slope. Probably of late Pleistocene age. 4800-4900 ft.

Other localities mentioned herein from which comparative material of other species of *Ashmunella* were obtained are:

6. *A. kochi* Clapp. New Mexico, Doña Ana Co., NW¼, Sec. 9, T. 19 S, R. 4 E. West slope of San Andres Mts., *ca.* .8 mil. ESE Ropes Spring. 6900 ft.

7. *A. kochi.* New Mexico, Doña Ana Co., NW¼, SW¼, Sec. 5, T. 23 S, R. 4 E. Organ Mts., Fillmore Canyon at "The Narrows." 7050 ft.

8. *A. organensis* Pilsbry. New Mexico, Doña Ana Co., NE¼, SE¼, Sec. 5, T. 23 S, R. 4 E. Organ Mts.; environs of Rock House Spring. 7850 ft.

9. *A. pasonis* (Drake). Texas, El Paso Co. 31°58′1″ N Lat; 106°30′45″ W Long. West side of Franklin Mts. at mouth of Vinton Canyon, the type locality of the species. 4900 ft.

Specimens have been deposited in the following museums: Academy of Natural Sciences of Philadelphia (Type, 319120; Paratypes, 319121 and 319122); United States National Museum (Paratypes, 681637); University of Michigan Museum of Zoology (Paratypes, 231087); Department of Biological Science, University of Arizona (Paratypes, 4366); Delaware Museum of Natural History, Paratypes (40844 and 40845).

Ashmunella rileyensis *new species* (Fig. 1, A-B)

Shell. Shell depressed and slightly angular around the upper periphery of body whorl; relatively narrowly umbilicate (for the genus), the umbilicus contained 4-6 times in the diameter; embryonic whorl smooth, succeeding whorls finely marked with delicate growth lines; second and third whorls sparingly and minutely papillose; fine spiral striae on base of body whorl (papillae and striae not observable except with considerable magnification); periostracum glossy, light tan in color except for inner surface of lip and teeth, which are white; aperture obliquely oriented; parietal callus exceedingly thin, same color as body whorl and scarcely discernable from it; two parietal teeth, the basal tooth longer, oblique, slightly sinuous, widest and highest anteriorly; dorsal parietal tooth shorter, lower, rising symmetrically to highest point, located centrally; three marginal teeth in outer lip, upper tooth rectangular, the two lower teeth longitudinally compressed, the upper one slightly longer.

Table 1. Proportions involving some characters of shells and genitalia of several species of *Ashmunella*. Locality numbers in parentheses are identified in text. Measurements taken as indicated in section "Measurements of Holotype." S.D.=standard deviation; N=number of specimens; l.=length; w.=width; dia.=diameter.

Character, Species, Locality	Range	Mean	S.D.	N
Shell dia./l. lower parietal tooth:				
A. organensis (8)	8.33-12.15	9.97	1.01	20
A. rileyensis (5)	8.79-8.87	8.83		2
A. rileyensis (4)	5.92-7.14	6.62	.33	10
A. rileyensis (2)	4.42-6.40	5.27	.23	44
A. kochi (7)	5.70-7.50	6.62	.44	25
A. kochi (6)	5.73-8.18	6.97	.33	16
Shell dia./w. of umbilicus:				
A. organensis (8)	5.54-7.55	6.66	.51	20
A. rileyensis (5)	5.38-6.76	6.02		4
A. rileyensis (2)	3.90-6.04	5.03	.52	44
A. kochi (7)	3.33-4.77	4.18	.34	25
A. kochi (6)	3.00-3.90	3.37	.20	16
Shell dia./w. of reflected lip:				
A. rileyensis (2)	13.55-20.43	16.75	1.77	44
A. kochi (7)	12.10-18.86	14.72	1.90	25
A. kochi (6)	12.29-15.45	13.73	.82	16
Penis l./free oviduct l.:				
A. rileyensis (2)	1.89-2.47	2.08		7
A. kochi (7)	1.52-1.80	1.66		2
A. kochi (6)	1.20-1.45	1.34		3
A. pasonis (9)	1.00-1.30	1.07		6

Measurements of Holotype. Whorls 5½; maximum diameter 14.7 mm; height 5.7 mm; umbilicus (measured as in Clench and Miller, 1966:3) 3.0 mm; length of upper and lower parietal teeth 1.5 and 3.0 mm; length of upper tooth of outer lip 1.8 mm; apertural height (between two ends of outer lip) 4.6 mm; greatest diameter of reflected lip (measured from surface behind aperture)

Table 2. Measurements (mm) of diameter and height of shell and several parts of the genitalia of seven paratypes (topotypes from Loc. 2) of *Ashmunella rileyensis*.

Shell diameter	15.0	14.0	14.6	14.2	16.4	13.8	14.1
Shell height	5.7	5.0	5.7	5.4	6.2	5.3	5.2
Atrium	1.7	___	1.7	2.0	2.1	1.5	___
Vagina	3.5	4.2	4.5	4.2	4.0	3.6	3.3
Free oviduct	2.8	2.5	2.9	2.7	2.2	2.1	1.7
Spermatheca and duct	41.5	36.0	36.5	38.1	39.7	38.0	23.0
Penis	5.3	4.9	5.6	5.2	4.5	4.9	4.2
Epiphallus	35.5	38.0	35.4	36.3	32.5	34.5	24.4
Flagellum	.9	.8	.8	.8	1.0	.7	1.0

.9 mm. Slight cracks, seemingly resulting from an injury to the shell that later healed, occur on part of the body whorl of the holotype and are discernable in Fig. 1, A-B.

Variation in Characters of Shell. Parietal dentition is less well developed in specimens from Southwest Mt. Riley (Locs. 3, 4) and in the fossils from Loc. 5 than in specimens from Northeast Mt. Riley (Locs. 1, 2). In the former specimens, the upper parietal tooth is absent or consists only of a minute swelling. The lower parietal tooth is shorter in populations from Southwest Mt. Riley and in fossil specimens (Table 1). The teeth of the outer lip are similar in size in northeastern and southwestern living populations but are extremely low in the fossils. The space between the two lower teeth of the outer lip is greater in southwestern and in fossil specimens. The umbilicus is narrower in the fossil than in the living specimens (Table 1).

Color. Sole whitish, light gray ventrolaterally and in entire caudal region, grading to dark gray on dorsal surface anteriorly; tentacles dark gray.

Genitalia. (Fig. 2). The upper sac of the penis is approximately half as wide as the lower sac. The upper sac of the penis comprises an upper, wider and a lower, narrower part; the lower part, thus, produces a prominent constriction in the penis (Fig. 2). The greater width of the upper part of the upper sac is produced by the presence of swollen tissue of glandular appearance. This mass

of tissue is somewhat C-shaped, investing *ca.* ⅔ of the periphery, with the two ends of the "C" greatly incurved, protruding inward to constrict the lumen and give it, in cross-section, the appearance of a trident (see enlarged x-sec. in Fig. 2). The penis is *ca.* 1.1-1.5 times as long as the vagina and 1.9-2.5 times as long as the free oviduct. A short penial retractor muscle originates on the epiphallus and inserts in the lung cavity lining. The area of muscle attachment on the epiphallus is connected to the upper sac of the penis by an enveloping fold of connective tissue. The area of insertion of this tissue varies from high to low on the upper sac. The flagellum is

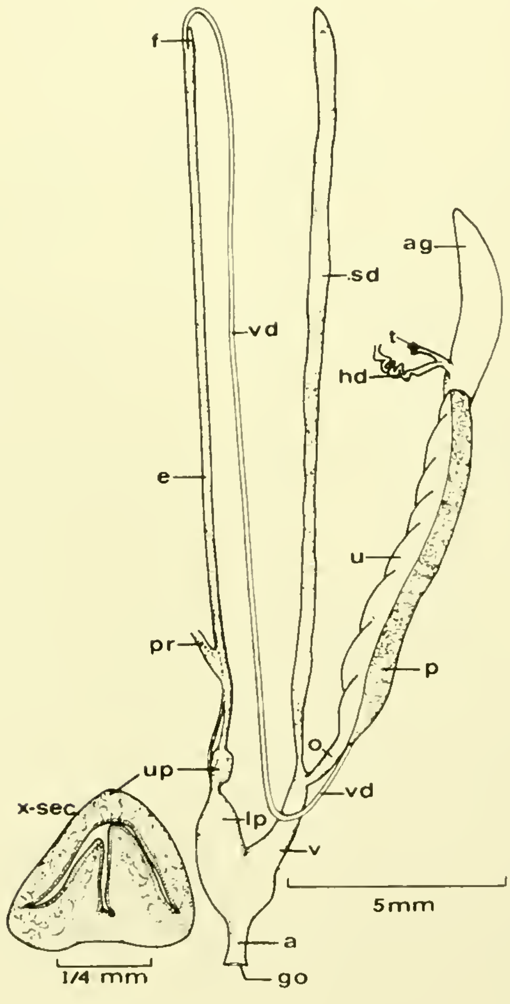

Fig. 2. Genitalia of *Ashmunella rileyensis* new species. Paratype (also topotype, Loc. 2) from Mount Riley, Doña Ana Co., New Mexico. a, atrium; ag, albumen gland; e, epiphallus; f, flagellum; go, genital orifice; hd, hermaphroditic duct; lp, lower sac of penis; o, free oviduct; p, prostate; pr, penial retractor; sd, spermathecal duct; t, talon; u, uterus; up, upper sac of penis; v, vagina; vd, vas deferens.

closely bound to the epiphallus. Both the epiphallus and the spermatheca vary greatly in length, perhaps depending on the presence or absence of a spermatophore as suggested by Webb (1954:17) for *Ashmunella rhyssa* (Dall). The talon consists of a relatively long, slender stalk with a well-defined central canal and small lobes at its end. Measurements of seven specimens are presented in Table 2.

Comparisons and Relationships

A. rileyensis belongs to the group of *Ashmunella* discerned by Pilsbry (1940:913-914) as having the upper part of the penis approximately half as wide at the lower part. His figure (1940: 525, 9) of *A. organensis* Pilsbry illustrates well this kind of penis. In addition to *A. organensis*, *A. kochi* Clapp from the San Andres and Organ Mts., New Mexico, and *A. pasonis* (Drake) from the Franklin Mountains, Texas, possess similar penial anatomy. Both *A. organensis* and *A. kochi* occur in the Organ Mts. The latter species was reported as *A. mearnsi* (Dall) by Cockerell (1897:69), was suggested as probably being referable to *A. kochi* by Pilsbry (1915:329), and was listed as *A. kochi* by Metcalf (1969:Table 1). This representative of *A. kochi* may be deserving of subspecific status; it has not been critically studied.

Although of questionable taxonomic significance, the atrium, spermatheca, and epiphallus are also similar in their relative proportions in the species noted above. In regard to shell characters, *A. kochi* from the Organ and San Andres Mts. and *A. rileyensis* have much in common. The flattened shell, oblique aperture, and number and arrangement of teeth are similar. *A. rileyensis* seems to resemble more closely the representative from the Organ Mts. in proportions of the shell and genitalia (Table 1) and both lack the deep-seated lamella behind the lip inside the last whorl found in *A. kochi* from the San Andres Mts. (Pilsbry, 1940:977). However, the umbilicus is significantly narrower in *A. rileyensis* than in *A. kochi* and closer to the extremely narrow umbilicus of *A. organensis* (Table 1). The lip is reflected to a greater degree in *A. kochi* and *A. pasonis* than in *A. rileyensis* (Table 1). *A. rileyensis* possesses a relatively longer penis and a shorter free oviduct than do specimens of *A. kochi* and *A. pasonis* (Table 1).

There seems little doubt that *A. rileyensis* is closely related to the *kochi-organensis-pasonis* complex and is probably closest to *A. kochi*.

However, the few fossil specimens of *A. rileyensis* recovered (Loc. 5) have a narrower umbilicus and more poorly developed dentition than any living specimens found (Table 1). In these characters they approach the condition of *A. organensis* (Table 1). Conceivably, then, *A. rileyensis* has evolved not from a snail like living *A. kochi,* but from some common ancestor (or another, extinct relative) of *A. kochi* and *A. organensis.*

The nearest known species of *Ashmunella* to the west of Mt. Riley are *A. mearnsi* (Dall) and *A. hebardi* Pilsbry and Vanatta of the Big Hatchet Mts. and *A. walkeri* Ferriss of the Florida Mts. In *A. mearnsi* and *A. walkeri,* the upper sac of the penis is wider than in the group of species discussed above; probably, then, *A. mearnsi* and *A. walkeri* are somewhat removed phyletically from that group.

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ON A SINISTRAL CHONDROPOMINE FROM JAMAICA

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While sinistral specimens of normally dextral land pulmonates have been more or less frequently reported, records of such teratological land prosobranchs are very rare, especially in the Pomatiasidae. Dautzenberg (1914, Bull. Soc. Zool. France, 39:

50-59) noted only eight pomatiasid species, all from the Old World, among the 195 he cited in which such monstrosities have been reported. He did not state how many specimens were involved.

The figure published here (fig. 1) is of a specimen of *Choanopoma* (*Colobostylus*) *jayanum* (C. B. Adams, 1850, Contr. Conch. 4: 50) from Jamaica, referred to but not illustrated by C. B. Adams (1851, ibid., 10: 194). It was collected by Rev. R. F. Holland, probably in Manchester Parish where Pilsbry & Brown (1910, Proc. Acad. Nat. Sci. Philadelphia, p. 522) and H. B. Baker (1935, Nautilus, 48: 65) noted the occurrence of the species. Apparently this is the only New World specimen of its kind ever reported, in spite of the fact that since the time of C. B. Adams the condropomine pomatiasids of the West Indies have been widely and intensively studied by many amateur and professional students alike. Three monographs of the group have been published (Torre & Bartsch, 1938, 1941; Bartsch, 1946) and vast numbers of specimens collected and examined. Hence this teratological specimen is of considerable interest. It was given to Bland by C. B. Adams and is now in the collection of the Museum of Comparative Zoology (262993).

Fig. 1. Normal and sinistral specimens of *Choanopoma* (*Colobostylus*) *jayanum* (C. B. Adams). c. 3x Photograph by courtesy of Robert C. Bullock.

STROMBUS GIGAS LINNAEUS FROM THE BOWDEN FORMATION, JAMAICA.

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On May 12, 1969, the Geology Department of the University of the West Indies, Kingston, Jamaica, improved the outcrop of the Bowden shell bed with the help of a bulldozer. This locality is the type locality of the Bowden Formation. Woodring (1928) assigned a late middle Miocene age to the Bowden Formation, whereas many paleontologists working with foraminifera consider it as Pliocene. The Bowden shell bed has been famous for more than a century for its abundant and well-preserved fossils. It is situated on the east side of Port Morant, St. Thomas, at the road opposite the Bowden Shop, i.e. 500 m NNE of the Bowden Wharf. Among the different groups of invertebrates the mollusks are best represented, i.e. by more than 600 species (Woodring 1925, 1928). Most of these species are of small or medium size. Large species (i.e. more than 100 mm in one dimension) are rare. As an exception to this rule Rutsch (1931) described a large species of *Strombus* and Palmer (1938) reported large specimens of *Spondylus bostrychites* Guppy from Bowden.

During the process of excavating a single, large, almost complete

Fig. 1. Apertural and dorsal view of shell of *Strombus gigas* Linné from the Bowden Formation, Jamaica.

specimen of *Strombus gigas* Linné was uncovered from a 30 cm thick, clayey and silty bed about 4 m above the present level of the road. Woodring (1928) recorded 3 species of *Strombus* from Bowden: *S. pugiloides* Guppy, *S. bifrons* Sowerby, and *S. leurus* Woodring. Three years later Rutsch (1931) described *S. dominator delabechei* based on two excellently preserved shells. He interpreted the fragment figured by Woodring (1928, p. 326, pl. 24, fig. 2) as *Strombus* species to be part of a *S. dominator delabechei.*

The most striking features of the specimen of *S. gigas* (pls. 1-3) are the two long spines and the somewhat irregular thickening of the spiral ridges on the dorsal part of the body whorl. The total number of spines on the body whorl is 7. The upper end of the outer lip reaches approximately the height of the apex. Basal canal bent backwards. Height of specimen: 25 mm; maximum diameter (including spines) : 220 mm.

The irregular thickenings of the spiral ornamentation on the dorsal side of the body whorl are similar to those of *S. samba* Clench a species which has been synoynmized with *S. gigas* by several authors. The tips of most of the larger spines are broken. The margin of the lower portion of the outer lip is damaged including the larger part of the stromboid notch. Protoconch and earliest whorls are not preserved. The ventral side and to a lesser extent also the dorsal side of the spire are covered with sponge borings.

Recent *S. gigas* lives in shallow water and ranges from Bermuda and southern Florida through the West Indies to northern South America (Clench and Abbott, 1941, p. 13; Warmke and Abbott, 1961, p. 88, map 3). Although it is most abundant locally, fossil records of *S. gigas* are rare. Gabb (1873, p. 234) listed *S. gigas* from the Miocene of the Dominican Republic, but this record has not been confirmed by Pilsbry (1922) in his revision of Gabb's Tertiary mollusks from the Dominican Republic nor by other authors (e.g. Maury 1917; Pflug 1961). Two well-preserved fossil shells of *S. gigas* are contained in the collections of the Natural History Museum Basel; they were collected from the Pleistocene part of the Coralrock Formation of Barbados.

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ANATOMY AND GEOGRAPHIC DISTRIBUTION OF THE SUCCINEID GASTROPOD, *SUCCINEA VAGINACONTORTA* LEE

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Succinea vaginacontorta Lee, 1951, Occas. Pap. Mus. Zool. Univ. Mich. No. 533: 1-7, pls. 2, text fig. 1; Miles, 1958, Univ. Kans. Sci. Bull. Vol. XXXVIII, Pt. II, No. 24: 1517-1519, Pl. 1C, fig. 4; Leonard, 1959, Handbook of Gastropods in Kansas, Univ. Kans. Mus. Nat. Hist. Misc. Pub. 20: 155-158, pl. 9, fig. 3.

While on a paleontological expedition in Meade County, Kansas, in June, 1942, Claude W. Hibbard noted what appeared to be an hitherto unknown species of *Succinea* living among clumps of grass and the sagebrush on slopes directly exposed to the sunshine. In the summer of 1950, members of the University of Michigan Paleontological Expedition to Kansas collected a series of this species which

was subsequently described by a C. Bruce Lee as *Succinea vaginacontorta* (Lee, 1951).

Succinea vaginacontorta Lee is a terrestrial gastropod of the high plains. For a period of over seventeen years attempts by the author. and others, to find this species in localities affording similar habitats outside of southwestern Kansas were unsuccessful. Miles (Miles. 1958) refers to Webb as having found this species at several other localities in Kansas. The author has not had the opportunity to examine those snails and, therefore, cannot verify those records. Since 1967, *S. vaginacontorta* has been found living in the badlands of South Dakota; Brown County, Nebraska; Sherman County, Texas; and San Migual County, New Mexico. Unlike most of the succineas, *S. vaginacontorta* is xerophilous. Its usual habitat is a treeless slope of a hillside supporting a ground cover of short grass. sagebrush, and lichens. This species appears on the surface in the summertime after rains have soaked the ground. During periods of drought it disappears and may not be seen again for months or even years. The stations from which *S. vaginacontorta* has been collected and a brief description of the local ecology of each, are:

Type Locality: Field No. 400. One and three-fourths mi. E. of Meade County State Park (SW corner of S 18, T 33 S, R 28 W), Meade County, Kansas. Altitude: 2390 ft. above sea level.

In the summer of 1950 when *Succinea vaginacontorta* was present on the surface, the type locality . . . "was a sagebrush flat on which hairy gramma grass (*Bouteloùa hirsuta* Lag.) was growing along a small creek . . ." (locally known as Cowland Creek). "The hairy gramma grass occurred in thick stands with a few small patches between the stands. The snails lived on the spots of lichens, mosses and occasional liverworts between these patches. Hibbard stated that the area is subject to intense droughts and periods of dryness alternating with spells of heavy rains. The snails were present in large numbers." (Lee, 1951, pp. 1-2.)

For over a period of 45 years the mean annual rainfall in Meade County, Kansas, has been 19.66″ (Hibbard and Taylor, 1960, p. 23). The greatest amount of rainfall occurs in the months of May-August. These months are marked also with periods of drought.

Claude W. Hibbard and the author visited the type locality in July, 1962. The area had been cleared, by application of herbicides, of most of the former stands of sagebrush and of all of the plumb

thickets. The sandy loam soil supported a growth of buffalo grass. *Succinea vaginacontorta* was not in evidence.

On June 10, 1969, Claude W. Hibbard revisited the locality. At that time, due to recent rains, the ground was moist to a depth of at least five feet. Water had collected in small ponds in depressions in the fields and pastures. *S. vaginacontorta* was found living around small plants of sagebrush and bunches of short blue stem grass. Apparently because sagebrush was becoming reestablished, *S. vaginacontorta* was reappearing as well.

Field No. 256. One-half mi. W. of Meade County State Park (SE ¼ of SW ¼, S 16, T 33 S, R 29 W), Meade County, Kansas. Altitude: 2630-2640 ft. above sea level.

The habitat is a treeless hillside. The author visited this locality the latter part of July, 1962. The sandy-loam supported a growth of sagebrush (*Artemisia* sp.), buffalo grass (*Buchloë* sp.), and hairy gramma (*Bouteloùa* sp.). Lichens were growing in exposed patches of soil as well as at bases of sagebrush and buffalo grass. The ground was wet from recent rains. A large number of *Succinea vaginacontorta* were found living on the crest of the hillside. They were most abundant in open patches where they were directly exposed to the sunshine. Several subsequent attempts by the author to find *S. vaginacontorta* at this locality have been unsuccessful because weather conditions have been unfavorable and the ground has been very dry.

Field No. 185. Meade County State Park (near the north line of NE ¼, S 15, T 33 S, R 29 W), Meade County, Kansas. Altitude: 2510-2520 ft. above sea level.

The habitat is a flat at the foot of a slope. The soil is a sandy silt covered with fine eolian silt. Claude W. Hibbard and the author visited this locality the latter part of July, 1954. The ground supported a growth of sagebrush (*Artemisia* sp.), buffalo grass (Buchloë sp.) and some gramma grass. Lichens and mosses grew in the shade of the sagebrush. The summer of 1953 had been exceedingly dry. In May, 1954, this area received a rainfall of 1¾". Another recent rainfall of 1¼" had provided enough moisture to make the ground muddy and for *Succinea vaginacontorta* to emerge from wherever this species aestivates during periods of drought. The snails were found living on the ground near the

TABLE I

DIMENSIONS and RATIOS of DIMENSIONS of SHELLS of SUCCINEA VAGINACONTORTA LEE

	No. of Whorls	Height	Width	Width/ Height	Height of Aperture	Width of Aperture	H. Ap./ H. Shell	W. Ap./ W. Shell	W. Ap. H. Ap.
Field # 400	3	11.6 mm	6.7 mm	.577	6.1 mm	4.1 mm	.526	.612	.672
Type Locality	3	10.7	6.1	.570	5.5	4.2	.514	.688	.764
Meade Co., Kans. June 10, 1969	3	10.1	6.5	.643	4.7	3.5	.465	.538	.745
Range (55 shells)	2 1/2 -3	4.9-11.6	3.0-6.7	.512-.701	2.9-6.1	1.8-4.2	.465-.686	.538-.841	.60-.827
Median		7.6	4.6	.594	4.5	3.2	.564	.689	.723
Field # 401	3 1/4	11.5 mm	6.1 mm	.530	6.1 mm	4.2 mm	.530	.688	.688
Meade Co., Kans.	3 3/8	11.4	6.1	.535	5.8	4.0	.509	.656	.689
July 6, 1969	3 1/3	11.3	7.6	.672	5.2	4.2	.460	.553	.807
Range (50 shells)	3 - 3 1/2	9.3-11.5	5.1-7.6	.526-.691	4.7-6.1	3.2-5.3	.423-589	.382-.946	.611-1.02
Median		10.2	6.0	.582	5.3	3.9	.520	.641	.725
Field # 256	3 3/8	12.3 mm	7.2 mm	.585	7.0 mm	4.1 mm	.569	.570	.586
Meade Co., Kans.	3 1/2	11.2	7.4	.661	6.7	4.5	.598	.608	.672
July 25, 1962	3 3/8	10.5	6.6	.629	6.3	3.8	.600	.576	.604
Range (19 shells)	3 1/2 - 3	7.7-12.3	5.1-7.4	.579-.74	5.0-6.7	3.3-4.5	.569-.702	.57-.691	.586-.70
Median		9.5	6.1	.637	5.9	3.7	.600	.622	.654
Field # 185 a	3 1/8	10.8 mm	7.3 mm	.676	6.8 mm	4.6 mm	.630	.630	.677
Meade Co., Kans.	3 1/4	10.7	7.0	.654	7.1	4.6	.663	.657	.648
July 24, 1954	3	10.5	6.9	.657	6.7	4.1	.638	.595	.595
Range (28 shells)	3 - 3 5/8	8.5-10.8	5.4-7.3	.619-.747	5.4-7.1	3.3-4.6	.604-.706	.578-.677	.595-.690
Median		9.7	6.5	.673	6.3	4.1	.644	.622	.655
Field # 185 b	3 1/4	10.8 mm	5.6 mm	.518	6.0 mm	3.6 mm	.555	.643	.600
Meade Co., Kans.	3 1/8	8.8	5.6	.636	5.5	3.7	.625	.661	.673
June 22, 1958	3 1/8	8.6	5.3	.617	5.2	3.5	.604	.661	.674
Range (31 shells)	2 7/8-3 1/4	6.5-10.8	4.1-5.6	.518-.709	4.1-6.0	2.3-3.7	.555-.697	.548-.731	.548-.790
Median		7.8	5.1	.647	4.9	3.1	.620	.645	.660

Field # 372	3 3/8	9.7 mm	5.6 mm	.578	5.8 mm	3.7 mm	.598	.661	.638
Brown Co., Nebr.	3	9.7	5.5	.567	5.6	4.2	.577	.764	.750
Aug. 8, 1967	3 1/4	9.4	5.3	.564	5.0	3.6	.532	.679	.720
Range (17 shells)	2 1/4-3 3/8	5.3-9.7	3.7-6.2	.564-.793	3.1-6.3	2.3-4.3	.532-.736	.469-.764	.547-.774
Median		7.4	4.7	.642	4.7	3.2	.607	.679	.694
Field # 372	3 1/4	9.1 mm	5.7 mm	.626	5.4 mm	3.5 mm	.593	.632	.666
Brown Co., Nebr.	3 1/4	9.0	6.0	.667	6.2	4.0	.690	.667	.645
May 31 & June 15, 1968	3 1/4	9.0	5.6	.622	5.6	3.4	.622	.607	.607
Range (26 shells)	2 3/4-3 1/4	5.4-9.1	3.3-6.0	.60-.74	3.3-6.2	2.4-4.1	.593-.765	.607-.732	.596-.762
Median			5.0	.662	4.8	3.3	.646	.667	.674
Field # 393	3 1/4	9.6 mm	6.5 mm	.677	6.1 mm	3.8 mm	.635	.585	.623
Washabaugh Co., S. Dak.	3 1/4	8.5	5.4	.635	5.2	3.4	.612	.630	.654
May 16, 1968	3 1/4	8.3	5.1	.615	5.4	3.5	.650	.687	.649
Range (5 shells)	3 - 3 1/4	7.6-9.6	4.8-6.5	.615-.677	4.9-6.1	3.2-3.8	.612-.65	.585-.688	.623-.674
Median		8.3	5.1	.635	5.2	3.4	.645	.653	.653
Field # 391	3 1/4	12.4 mm	8.8 mm	.710	8.4 mm	5.7 mm	.687	.648	.629
Sherman Co., Texas	3 3/8	12.0	7.8	.650	7.6	5.7	.633	.731	.737
August, 1968	3 1/4	10.5	7.0	.667	7.3	4.8	.695	.686	.657
Range (37 shells)	3 3/8-2 7/8	6.1-12.4	4.3-8.8	.605-.743	4.3-8.4	2.9-5.7	.617-.73	.60-.712	.617-.737
Median		8.0	5.5	.667	5.5	3.7	.671	.667	.666
Field # 365	3	9.5 mm	6.4 mm	.674	6.4 mm	3.8 mm	.674	.594	.594
San Migual Co.,	3	9.3	6.1	.656	6.0	3.7	.645	.607	.617
N. Mexico	3	8.7	5.7	.655	5.7	3.5	.655	.615	.615
September 10, 1967									
Range (17 shells)	2 1/2-3 1/8	6.0-9.5	3.8-6.4	.506-.675	3.2-6.4	2.2-3.8	.53-.689	.579-.763	.566-.757
Median		8.3	5.1	.625	4.9	3.2	.605	.627	.636

sagebrush and among bunches of buffalo grass and, also, on bare spots of ground.

When the author revisited this locality on July 25, 1962, she found what had been, in 1954, bare spots on the mudflat and on the hillside had become covered with tall grasses and weeds as a result of a greater amount of rainfall in the previous two years. Apparently the denser vegetation was the cause for the reduced population of *S. vaginacontorta.*

Field No. 401. Meade County, Kansas, (SW ¼, S 22, T 33 S, R 29 W). Altitude: 2535 ft. above sea level.

The soil, a sandy silt, of this locality which is a sagebrush flat, supports a growth of sagebrush, lichens, and a small amount of grass. Rains which fell in the middle of June, 1969, had moistened the ground sufficiently for *Succinea vaginacontorta* to appear on the surface. On July 6, 1969, Claude W. Hibbard and members of his field party collected about forty live snails off the bare, moist. ground.

Field No. 372. Six mi. N. of Ainsworth, (SE ¼, S 25, T 31 N, R 22 W) Brown County, Nebraska. Altitude: 2450 ft. above sea level.

Succinea vaginacontorta obtained from this locality was collected by Claude W. Hibbard. The habitat of this species at this station is comparable to those of Meade County, Kansas. The soil is a sandy silt. Most of the snails collected on May 31, and June 15, 1968, were found along the rim at the top of a low bluff, living under yucca and on patches of liverwort growing between clumps of little blue stem grass. Those snails which had been washed down into the stream valley were living on the grassy flood plain on the bare ground between clumps of little blue stem grass about a foot above the sandwash channel. Here, as in Meade County, Kansas, the snails were active after a 1½″ rainfall.

Filed No. 393. Fifteen mi. S. of Kadoka, Washabaugh County, South Dakota, along South Dakota State Hgwy. 73, in the South Dakota Badlands.

This locality is at the rim of grass where Oligocene beds are exposed. *Succinea vaginacontorta,* collected by Bruce Cornet, University of Michigan, on May 16, 1968, was found living on the edge of sparse grassland on bare strips between bunches of grass. (Claude W. Hibbard, personal communication, Nov. 12, 1968.)

Field No. 391. Two miles S. of Stratford, Sherman County,

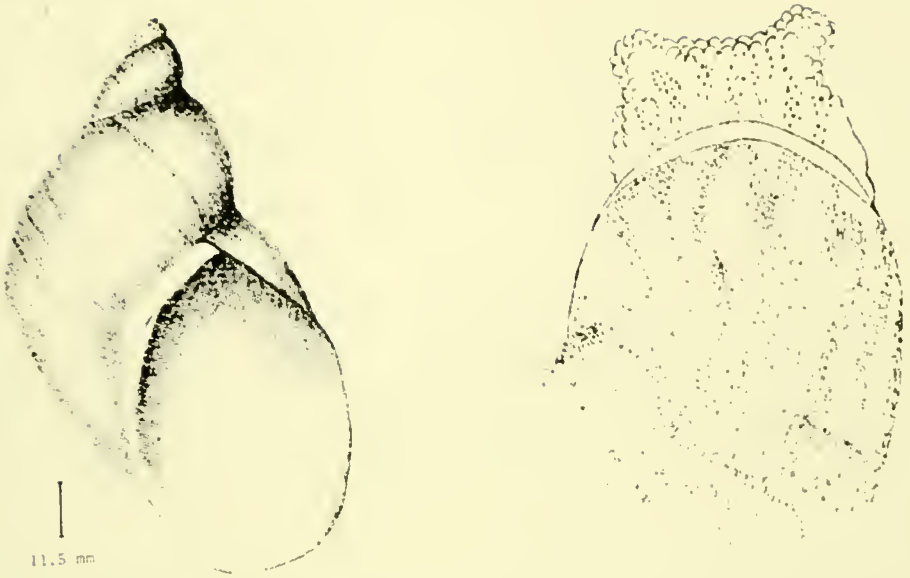

Fig. 1 (left). Drawing of a shell of *Succinea vaginacontorta* Lee from the type locality. (Right) Drawing of head anterior body region and mantle of *Succinea vaginacontorta* Lee showing patterns of pigmentation.

Texas, along U.S. Hgwy. 287. Altitude: 3970 ft. above sea level.

The Ogallala Formation forms a caprock at the top of bluffs rimming the south wall of Coldwater Creek Valley. Much rock debris accumulates on the slopes. Plants of this area are predominantly grasses *Andropogan* sp. and *Boutelоùa sp.*) and some *Yucca glauca. In August,* 1968, Artie Metcalf (personal communication, August 26, 1968) collected *Succinea vaginacontorta* which were aestivating under limestone rocks of the Ogallala Formation and under stems and dead caudices of *Yucca glauca.*

Field No. 365. One-half mi. N. of Romeroville, San Migual County, New Mexico. Altitude: 6430 ft. above sea level.

This habitat is a roadside ditch along Interstate Hgwy. 25. In some places in the ditch the water was 6″ deep. *Succinea vaginacontorta,* collected by Artie Metcalf, was concentrated on mud along the edge of the water and back several inches where the ground was still moist. The general habitat was grassland with scattered juniper and pinyon pine. (Artie Metcalf, personal communication, November 26, 1968.)

THE SHELL. The dull, grayish amber, translucent, ovate shell of *Succinea vaginacontorta* is composed of from 2½ to slightly more than 3½ convex, sharply incised whorls which increase rapidly in size from the acute spire to the body whorl. Although the shell is fragile, it is of the heavier, more solid succineid shells — comparable

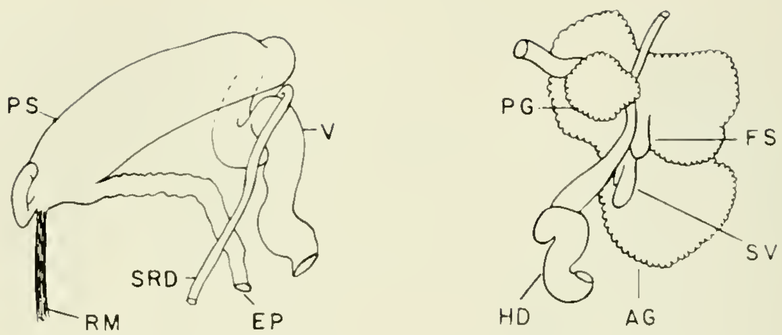

Fig. 2 (left). Anterior genitalia of *Succinea vaginacontorta* Lee. PS, penial sheath; RM, retractor muscle; SRD, seminal receptacle duct; EP, epiphallus; V, vagina. (Right) Albumin gland, prostate gland and associated structures of *Succinea vaginacontorta* Lee. PG, prostate gland; HD, hermaphroditic duct; AG, albumin gland; SV seminal vesicles; FS, fertilization sac.

to those of *S. campestris* Say and *S. luteola* Gould. The nuclear whorl is finely punctate. The remaining whorls are marked with striae, fine on the penultimate whorl, becoming heavier and coarser until they produce a rough appearance on the surface of the ultimate whorl. Due to the heavy striations the shell, when stripped of its periostracum, has a striped appearance.

As is to be noted in Table I, the shell attains a height of up to almost 12.5 mm and a width of up to 8.8 mm (Field No. 391, Sherman Co., Texas, and Field No. 256, Meade Co., Kansas). According to observations based on this study, the maximum heights of shells of *S. vaginacontorta* appear to be attained by the latter part of July and early August. The ovate aperture, ranging from 52.6% to 68.7% of the height of the largest shells obtained from the several stations, is bounded by a sharp peristome which continues over the body whorl as a thin callous. Other dimensions and ratios of dimensions are to be noted in Table I. The columella is gently curved, Figure 1.

The Body. The surface of the translucent, dull grey-white body is coarsly and irregularly tuberculated. The tubercles are most apparent on the surface of the head and the sides of the body; they are more prominent when the body is contracted than when relaxed. Generally the body is so lightly pigmented that it is difficult to recognize any distinct pattern. When intense enough to be discerned, the pattern is the form of a mottled broad band on the anterior dorsal surface of the head (Figure 2). At the level of the posterior tentacles this broad band divides into a median and two lateral bands which extend to the edge of the mantle. The pigmenta-

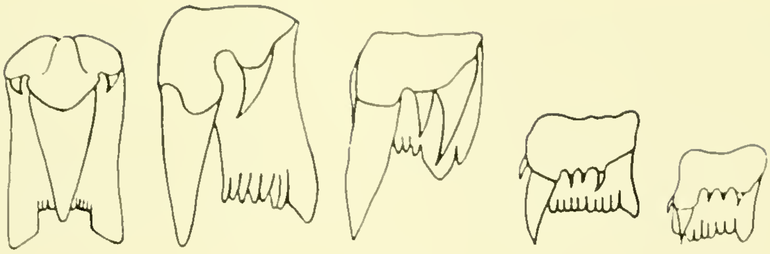

Fig. 3. Representative teeth of a radula. C, center; 1-R-L, first right lateral; 1-R-M, first right marginal; 9-R-M, ninth right marginal; 11-R-M. eleventh right marginal.

TABLE II

STATION		No. of Rows of Teeth	Row	M	L	C	L	M
No. 400 Meade Co., Kansas Type Locality	(A)	83	35	11	10	1	12	8
			41	12	8	1	11	10
			52	?	10	1	12	9
			69	?	11	1	11	10
	(B)	101	40	11	8	1	8	10
No. 185 Meade County State Park, Kansas		80	28	5	7	1	10	10
			40	9	9	1	9	11
No. 391 Sherman Co., Texas		80	22	11	13	1	10	13
			25	11	13	1	11	12
			29	11	13	1	11	12

Table II. Formulae of representative rows of teeth of *Succinea vargina-contorta* Lee.

tion of the surface of the mantle varies from a pattern of irregular bands extending to the border of the kidney to one that is a combination of overall diffuse, fine stripes and blotches. Blotches of pigmentation outline the kidney and appear also over its surface (Figure 2). The collar of the mantle may be unpigmented or finely peppered in the form of an irregular band. The lateral surface of the body is coarsly and irregularly tuberculated and sparsly pigmented. The body wall is incised by shallow vertical grooves which extend to the margin of the foot resulting in a scalloped edge. A shallow pedal groove and a shallow suprapedal groove run posteriorly from the labial palp. The genital aperture is in the form of an elongate crescent.

Although the anatomy of the reproductive system of *Succinea vaginacontorta* resembles, generally, what is characteristic of the genus, this species manifests certain structural features of the penial sheath, penis, epiphallus, vagina and prostate gland which are distinctive. The penis is enclosed in a penial sheath which is slightly peppered with black pigment, thick and opaque rather than thin and translucent. Fibers of the wall of the penial sheath extend onto and are fused onto the surface of the penis. The penis is a straight, tubular structure, i.e. it is accommodated within the length of the sheath and does not recoil. The epiphallus, noticeably short and stout, enters the penial sheath about one-fourth of its distal end, emerges distally, loops, reenters through the same aperture, and enters the penis terminally. The retractor muscle is attached to the distal end of the sheath near the edge of the aperture through which the epiphallus loops (Figure 3). A thin, slightly peppered sheath encloses the white, small, globular, follicular prostate gland (Figure 4.)

The convoluted oviduct joins the straight, heavy-walled uterus which joins an inflated, thick-walled, peculiar S-looped vagina with which the spermatheca duct is connected. As the vagina approaches the common genital antrum it becomes thin-walled and straight (Figure 4). A thin, sometimes slightly pigmented sheath covers the elongate, follicular albumin gland. The twinned seminal vesicles, unequal in length, and the hermaphroditic duct are pigmented, and open into the fertilization sac (Figure 4).

The Radula and Jaw. The structure of the radula of *Succinea vaginacontorta* is characteristic of the genus. The number of rows of teeth range from about eighty to one-hundred. The ratio of laterals to marginals approaches 1:1 which has been found to be true of, also, *S. ovalis* Say (Frazen, 1959, Table II). The number of teeth of representative rows of radulae are to be noted in Table II.

Structure of representative teeth are illustrated in Figure 5. The central tooth has a long, sharply pointed mesocone which equals or exceeds in length that of its basal plate. The mesocone is flanked on either side by a smaller ectocone. The laterals have a long, sharply pointed mesocone which, generally, exceeds in length that of its basal plate. There is a single ectocone. The endocone is generally wanting. The marginals are characterized by a short

endocone, a long, sharply pointed mesocone, and an ectocone which is divided into two or three short teeth. The differentiation between laterals and marginals is not always sharply defined. Sometimes an endocone appears in the outermost laterals. On either side of a lateral with a split ectocone may be one with an undivided ectocone. The basal plates of the marginals are as in *Succinea ovalis* Say (Franzen, 1959, Fig. 3). They are not long and tapering as in the genus *Oxyloma* (Franzen, 1963, Fig. 1) nor as short and broad as in the genus *Catinella* (Quick, 1933, Fig. 4).

The amber colored jaw has a large, rounded median fold which projects anteriorly. It lacks the series of small lateral folds characteristic of the jaw of *Succinea ovalis* Say (Franzen, 1959, Fig. 2).

Chromosomes. Tissues of gonads of *Succinea vaginacontorta* of several localities were squashed and stained with orcein. The most successful preparations were made of snails from locality 391, Sherman County, Texas. Examinations of the stained chromosomes in metaphase revealed a haploid number of eighteen.

Discussion. *Succinea vaginacontorta* is a xerophilous terrestrial gastropod of the high plains of the United States. Its known range of geographic distribution extends from northcentral Nebraska (100° long., 42°50′ lat.), southwestern South Dakota (100°50′ long., 43°70′ lat.), southwestern Kansas (100°50′ long., 37°25′ lat.), northwestern Texas (102° long., 36°10′ lat.), northwestern New Mexico (105°20′ long., 35°50′ lat.). Its range in altitude is from 2450 ft. (Nebraska) to 6430 ft. (New Mexico) above sea level.

Succinea vaginacontorta shares some habits, shell and anatomical features with several other species of Section Calcisuccinea Pilsbry (Pilsbry, 1948, p. 826). *Succinea campestris* and *S. luteola,* living near marine shores, aestivate for periods of time while the ground is dry. The shells of these three species are translucent but not as fragile as is true of many succineas. Coarse surface striations are characteristic of the shells of these three species. Those of *S. luteola* and *S. vaginacontorta* give to the shells a similar appearance. Anatomical characteristics shared by the three species include the coarse tubercles as well as the light amount of pigmentation on the surface of the body, a globular rather than an ovate prostate gland, a short and stout epiphallus which enters the penial sheath, emerges distally, loops and reenters the sheath. The penial sheath of *S. campestris* is thick-walled but no fibers extend from it to the

surface of the penis as in *S. vaginacontorta*. The penial sheath of *S. luteola* is thin.

The distinctive anatomical feature of *S. vaginacontorta* is the peculiar S-looped vagina. Shell dimensions and ratios of various dimensions of the three largest shells taken from each locality, and the time of year taken, are to be noted in Table I. Because the author has not, as yet, made similar studies of other species of *Succinea*, comparisons of shell dimensions and ratios cannot be made at this time. The more significant ratios are, apparently, those of the larger shells, namely, those which were taken in the latter part of July or August.

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Miles, Charles D. 1958. The Family Succineidae (Gastropoda: Pulmonata) in Kansas. Univ. Kans. Sci. Bull. *38*, Pt. 2, No. 24 (Mar. 20) : 1499-1543, Pl. 1, Figs. 1-8.

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NOTES

New Northern Extension of the Range of Assiminea modesta (H. C. LEA) —*Assiminea modesta* (H. C. Lea, 1845) has been reported from Brooklyn, N. Y. north to Newport, R. I. (Johnson, 1934. Proc. Boston Soc. Nat. Hist., *40*(1): 97). I have recently found this species at three separate localities north of Cape Cod, Mass. On October 18, 1968 I collected numerous dead specimens in the jetsam at the edge of a salt marsh at the end of Harbor Road, Sandwich, Mass. Additional dead specimens were collected at the same locality April 9, 1969. On October 26, 1969 four living specimens were found under boards at the high tide level on the west side of the same salt marsh. At Orient Heights, East Boston, on the west side of Belle Isle Inlet, living specimens were rather common under stones, boards, and especially under tarpaper scraps (April 29, 1969). At North Scituate on the west side of a salt marsh near the intersection of Border Road and Gannett Street, *A. modesta* was plentiful under chunks of peat that had been excavated from drainage canals. *A. modesta* was always found in association with *Melampus lineatus* (Say, 1822) and *Ovatella myosotis* (Draparnaud, 1801).

Shell morphology of two-thirds of the specimens from East Boston is as described by Lea (1845. Proc. Boston Soc. Nat. Hist., *1*: 205; 1847. Boston Journ. Nat. Hist., 5: 288); the remaining specimens from this locality were pure, translucent white, appearing grayish due to the animal inside. All other specimens were the normal horn color, with dead specimens slightly lighter in color. Neither Lea nor Verrill (1880. Am. Journ. Sci., *20*: 250) described the animal. Comparison of the animals from North Scituate with the description given by Balch (1899. Proc. Boston Soc. Nat. Hist., *29*(7): 143 and pl. 1) revealed that the former had but one eye spot per eye stalk rather than "each [peduncle] bearing two conspicuous large black eye-spots" described by Balch. Figures by Balch and Verrill (1884. Trans. Conn. Acad., *5*(1): pl. 58) indicate the same double eye spot.

When Verrill reported the occurrence of *A. modesta* at Newport, R.I. he stated: "Whether these shells have been accidentally introduced, at that point, by shipping, or are really indigenous cannot at present be determined . . . They may have been overlooked hitherto." This may be true as well for the specimens recently

collected, for although the species is an active one, it is also very small and rather localized. Representative specimens have been deposited at the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts and the Delaware Museum of Natural History, Greenville, Delaware. It is probable that *A. succinea* Pfeiffer, 1840, is an earlier name for this species. —Walter P. Baranowski, East Walpol, Massachusetts 02032.

NEWS

Green Snail Protected — The pulmonate land mollusk, *Papustyla pulcherrima* (Rensch), of Manus Island, Admiralty Islands, is now on the official list of endangered species of foreign wildlife (see Federal Register vol. 35, no. 106, June 2, 1970, and no 233, December 2, 1970). The new federal law prohibits bringing this species into the United States, except for scientific or educational purposes, and then only by obtaining a permit prior to importation, from one of the five regional directors of the Bureau of Sport Fisheries and Wildlife, U. S. Department of the Interior. For a list, write the Bureau in Washington, D.C. 20240.

G. Dallas Hanna, distinguished zoologist, geologist and malacologist, died at the age of 83, on November 20, 1970. He was Curator of the Department of Geology of the California Academy of Sciences.

Dennis Harper Kennelly, conchologist at the East London Museum in South Africa, and author of "Marine Shells of Southern Africa" (1964) died at East London on February 11, 1971, at the age of 80.

We regret to announce the death of Dr. Harold Sellers Colton, on December 29, 1970, at the age of 89, in Flagstaff, Arizona. He was a Professor Emeritus of Zoology at the University of Pennsylvania, and published on the ecology and variation of marine and fresh-water mollusks from 1904 to 1934. He retired to Arizona in 1926 and founded the Museum of Northern Arizona.

We regret to announce the death of Dr. Gunnar Thorson, on January 25, 1971, at the age of 64, in Denmark. He was Europe's leading malacologist on the subject of reproduction and ecology of marine mollusks. He was the founder of the Marine Biological Laboratory in Helsingor.

The Delaware Museum of Natural History in Greenville, Delaware, has added Mr. Russell H. Jensen to the staff of its Department of Mollusks as an Assistant Curator. Mr. Jensen is at present preparing a handbook of the marine mollusks of Bermuda.

PUBLICATIONS RECEIVED

Rios, Eliézer de Carvalhos. 1970. Costal Brazilian Seashells. 225 pp., 60 pls. Paperback. A checklist of the marine shelled mollusks of Brazil with illustrations of 280 native species.

Cernohorsky, Walter O. 1970. Systematics of the families Mitridae and Volutomitridae. Bull. Auckland Institute and Museum, no 8, 190 pp., 18 pls. Excellent review of higher taxa.

La Conchiglia. Dec. 1970. Vol. 2, nos. 11-12. International edition (in English) of the Italian shelling magazine. Contains new monthly supplements to Van Nostrand's Standard Catalog of Shells. Yearly subscription: $8.50 (airmail $10.50). U. S. agents: W. and R. McCauley, 7914 Provident St., Philadelphia, Pa. 19150; Gordon Melvin, 863 Watertown St., West Newton, Mass. 02165.

Proceedings of the Symposium on Mollusca held at Cochin. 1968-1969. Symposium Series 3, Marine Biol. Assoc. India, Mandapam Camp, India. Part I, pp. 1-385 (1968); Part II, pp. 387-706. Contains 58 papers on marine, land and fresh-water mollusks, including a new *Neopilina,* and a new genus of nudibranchs, *Annulorhina,* Rao, 1968.

Johnson, Richard I. 1970. The Systematics and Zoogeography of the Unionidae of the South Atlantic Slope Region. Bull. Mus. Comp. Zool., vol. 140, no. 6, 449 pp., 22 pls.

CONTENTS

INDEX TO AUTHORS